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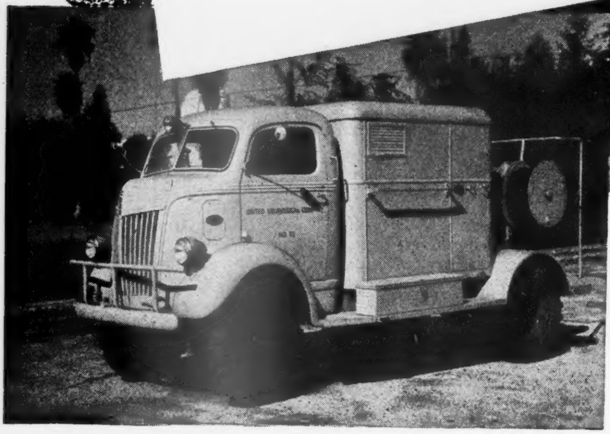

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Will the U.S. run out of oil in a few years?

Yes, said Navy Secretary Frank Knox last week before the House Naval Affairs Committee. He predicted a serious shortage of crude oil within a year. Within 14 years the U.S. will be a "have-not" nation in oil, he said, when the last drop of its oil fields is drained (if the present rate continues). Same day, Assistant Deputy Petroleum Administrator Robert E. Allen warned that the U.S. is threatened with a permanent oil shortage in two years unless "miraculously prompt" discovery of new fields offsets declining production. The U.S. must bring in 20,000 new wells a year, said he, to maintain present production.

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MAY, 1944

STRATIGRAPHY OF COTTON VALLEY BEDS OF NORTHERN GULF COASTAL PLAIN[1]

FREDERICK M. SWAIN[2]
State College, Pennsylvania

ABSTRACT

The Upper Jurassic Cotton Valley beds comprise an entirely subsurface sequence of sandstone, shale, and limestone in southern Arkansas, northern Louisiana, northeastern Texas, central Mississippi, and western Alabama. It is herein demonstrated that this sequence, originally defined as a formation, contains two units of formational rank which comprise the Cotton Valley group. The lower of the two formations is herein named the Bossier formation. It consists of dark gray shale and sandstone in north-central Louisiana and southern Arkansas, where it attains a thickness of 1,900 feet, and passes eastward into redbeds in the Monroe uplift of northeastern Louisiana. It extends slightly into southern Arkansas where it is overlapped by the upper formation of the Cotton Valley group, herein named the Schuler formation. This formation comprises two members differentiated by lithology and color, and exceeds 2,300 feet in maximum thickness. The lower member, herein named the Shongaloo member, consists of nearshore red shale, sandstone, and conglomerate and equivalent offshore fossiliferous gray shale, limestone, sandstone, and basal conglomerate. The upper member, herein named the Dorcheat member, comprises nearshore pastel, varicolored shale and sandstone, and equivalent offshore fossiliferous gray shale, sandstone, and limestone.

Paleontological information contributed by R. W. Imlay indicates that the Bossier formation is middle and upper Kimmeridgian, and that the Schuler formation may be Portlandian and Tithonian.

INTRODUCTION

The Upper Jurassic Cotton Valley sediments comprise a thick, entirely subsurface, sequence found in deep wells in northeastern Texas, southern Arkansas, northern Louisiana, central Mississippi, and western Alabama. The geographic distribution of the approximately 160 wildcat wells which have so far penetrated the Cotton Valley is as follows: southern Arkansas 106, northern Louisiana 35, northeastern Texas 15, central Mississippi 3, western Alabama 1. The Upper Jurassic rocks of southern Arkansas and northern Louisiana have produced large amounts of petroleum, and wildcat drilling to these rocks continues to be active. During the past few years, drilling has been extended to outlying areas of northeastern Texas, Mississippi, and Alabama.

[1] Manuscript received, October 22, 1943.

[2] Assistant professor of mineral economics, The Pennsylvania State College.

TABLE I. Summary of Subsurface Pre-Upper Cretaceous Stratigraphy of Southern Arkansas, Northern Louisiana, and Northeastern Texas
(Modified after R. W. Imlay, 1940)

SYSTEM	EUROPEAN EQUIVALENT	GROUP	FORMATION	LITHOLOGY	MAXIMUM THICKNESS IN FEET	REMARKS
CRETACEOUS (Comanchean Series)	Upper Albian	Washita	Undifferentiated	Shale, limestone, marl.	100+	
	Middle Albian	Fredericksburg	Kiamichi Goodland Walnut	Shale and some limestone Limestone Shale	400+	
	Lower Albian	Trinity	Paluxy	Red and grey shale, sandstone, limestone	1200+	Produces oil and gas-distillate in eastern Texas, northern Louisiana, southern Arkansas.
			Glen Rose Sub-Group: Mooringsport	Gray and red shale, limestone and sandstone	750+	
			Ferry Lake	Thick-bedded anhydrite and thin layers of limestone and shale.	500+	
			Rodessa	Partly oolitic limestone, gray and red shale	500+	Produces oil, gas and distillate in Arkansas, Louisiana, and Texas.
			Pine Island	Gray and red shale, thin limestones.	500+	
	Aptian		Sligo	Partly oolitic limestone, gray and red shale.	300+	Produces oil and gas in Arkansas, Louisiana, and Texas.
	Neocomian	Coahuila	Hosston	Red-green shale, sandstone	2300+	Produces oil and gas in Arkansas, Louisiana, and Texas.
JURASSIC (Upper)	Tithonian — ? — Portlandian — ? —	Cotton[a] Valley	Schuler[a]	Pastel varicolored shale, gray shale, limestone, white sandstone (Dorcheat member)[b]. Red-green shale, gray sh., limestone, red and white sandstone (Shongaloo member)[b].	2300+	Produces oil and gas-distillate in Arkansas, and Louisiana.
	Kimmeridgian		Bossier[b]	Grey and red shale, sandstone and limestone	1900+	Produces oil in Arkansas (Schuler Field)
			Buckner	Red and grey shale, anhydrite, dolomitic limestone, oolitic limestone.	500+	
	Oxfordian		Smackover	Oolitic limestone, dense limestone, dolomitic limestone, minor shale and sandstone.	1200+	Produces oil and gas-distillate in Arkansas and Louisiana
			Eagle Mills	Red shale, sandstone, and salt	1250+	
PENNSYLVANIAN ?			Morehouse	Gray and red shale, sandstone, and limestone.	1190+	See Imlay & Williams, Bull. A.A.P.G., Vol. 26, No. 10, 1942, pp. 1672-73.

a- Modified usage in this paper.
b- New Name in this paper.

The pre-Upper Cretaceous stratigraphy of the area, which is summarized in Table I, has been discussed by W. B. Weeks,[3] R. T. Hazzard,[4] and R. W. Imlay.[5] Other early descriptions of these rocks are to be found in papers by H. K. Shearer[6] and by Grage and Warren.[7] These works provide a background for the present paper, the purpose of which is to present details of Cotton Valley stratigraphy based on a study of well cuttings, cores, and electrical logs.

Acknowledgments.—Many of the sample records of early wells used in this study were prepared by W. B. Weeks and C. W. Alexander of the Phillips Petroleum Company, and in addition these men provided much helpful information as the work progressed. R. W. Imlay of the United States Geological Survey contributed important paleontological information, made valuable suggestions, and read the manuscript critically. R. C. Moore, of the University of Kansas, outlined the work, directed its course of procedure, and made other helpful suggestions. P. D. Krynine, of the Pennsylvania State College, aided in petrographic examinations. The writer is deeply grateful to these and to the following geologists for their aid and encouragement: C. I. Alexander, Jules Braunstein, H. M. Cox, W. M. Furnish, R. T. Hazzard, C. J. Hoke, J. H. McGuirt, T. H. Philpott, Joseph Purzer, Van D. Robinson, and R. B. Totten.

Appreciation is expressed to C. O. Stark and D. E. Lounsbery, of the Phillips Petroleum Company, for permission to use the well information embodied in the study and to the Union Producing Company for permission to reproduce a portion of the electrical log on their No. A-1 McDonald well, North Lisbon Field.

Detailed Stratigraphy

COTTON VALLEY GROUP

The name "Cotton Valley formation," first used by H. K. Shearer,[8] was formally proposed and defined as a new stratigraphic name by R. T. Hazzard for the Shreveport Geological Society.[9] The type locality was designated as the Cotton Valley field in Webster Parish, Louisiana,[10] and the original definition

[3] W. B. Weeks, "South Arkansas Stratigraphy with Emphasis on the Older Coastal Plain Beds," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 22, No. 8 (August, 1938), pp. 953–83.

[4] R. T. Hazzard, "Notes on the Comanche and Pre-Comanche? Mesozoic Formations of the Ark-La-Tex Area: and a Suggested Correlation with Northern Mexico," *Shreveport Geol. Soc. Guide Book, Fourteenth Annual Field Trip*, (1939), pp. 155–78.

[5] R. W. Imlay, "Lower Cretaceous and Jurassic Formations of Southern Arkansas, and Their Oil and Gas Possibilities," *Arkansas Geol. Survey Inf. Cir. 12* (1940).
———, "Jurassic Formations of Gulf Region," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 27, No. 11 (November, 1943), pp. 1407–1533.

[6] H. K. Shearer, "Developments in South Arkansas and North Louisiana in 1937," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 22, No. 6 (June, 1938), p. 724.

[7] V. P. Grage and E. F. Warren, Jr., "Lisbon Oil Field, Claiborne and Lincoln Parishes, Louisiana," *ibid.*, Vol. 23, No. 3 (March, 1939).

[8] H. K. Shearer, *op. cit.*, p. 724.

[9] R. T. Hazzard, *op. cit.*, p. 156.

[10] No well in the Cotton Valley field has completely penetrated the Cotton Valley beds. The deepest well in the field (stratigraphically) is Hunt's Babb No. 8 which stopped in the upper part of the Shongaloo member of the Schuler formation (Fig. 4).

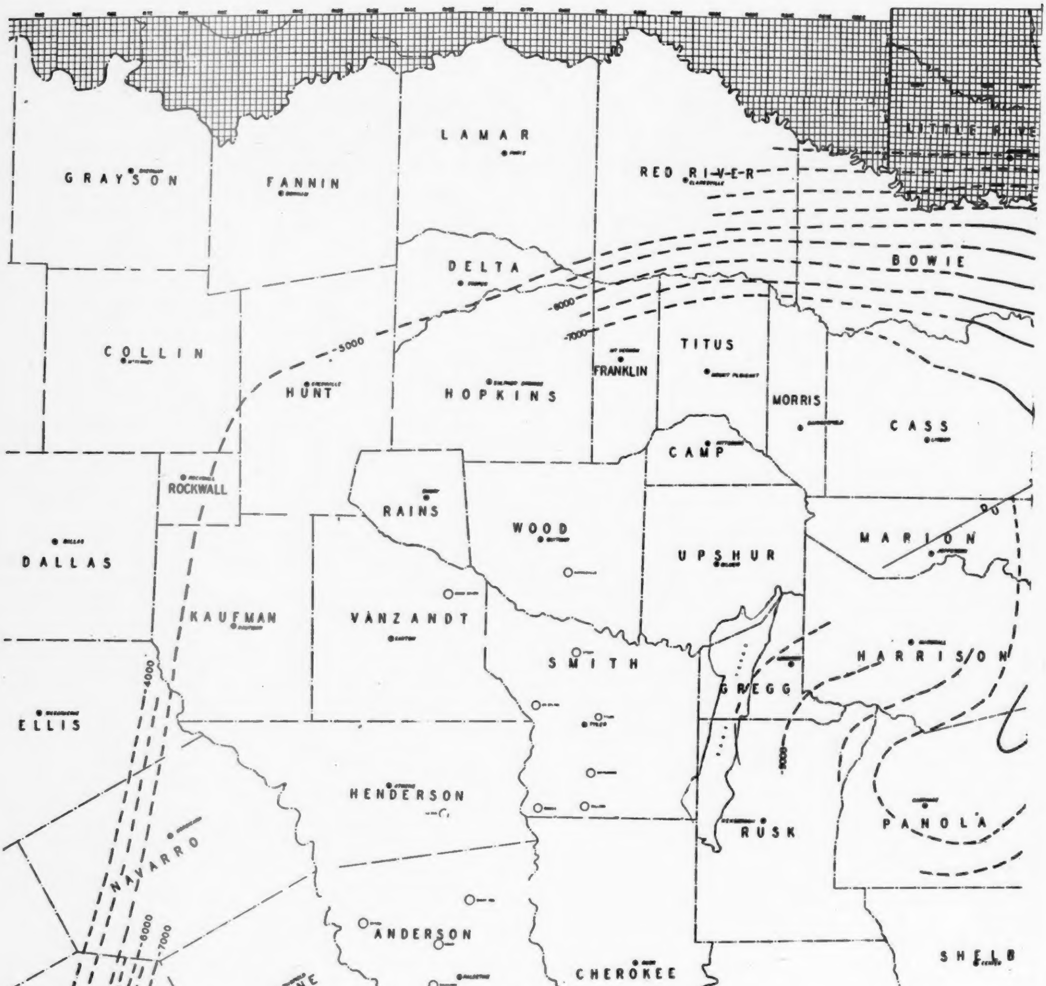
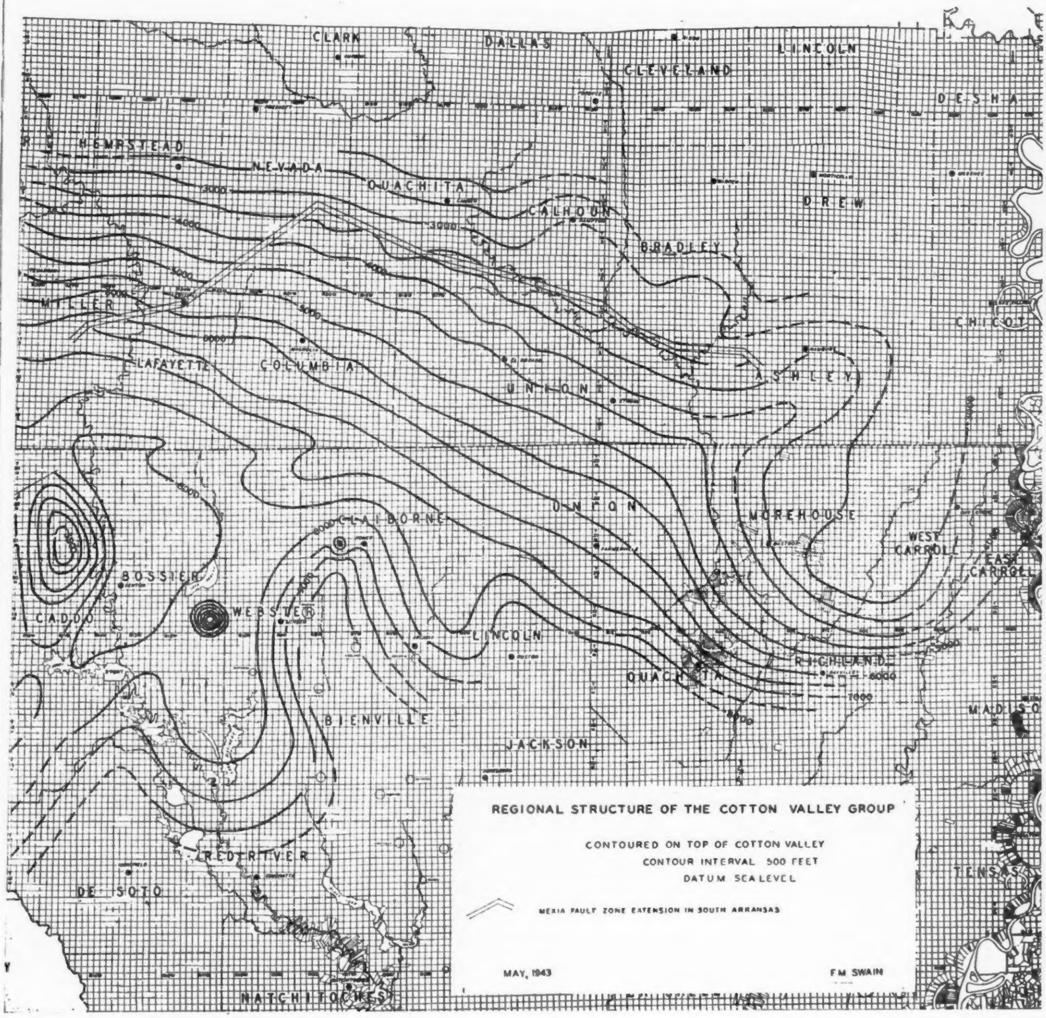


FIG. 1.—Regional structure



of Cotton Valley group.

was "the marine, fossiliferous, dark shales, limestones, and sandstones lying immediately below the Hosston red beds." It was recognized that at the north, updip, the marine rocks passed into "red beds" of essentially non-marine character, which were named the Schuler facies, from the Schuler field in Union County, Arkansas. The present writer demonstrates herein that the Cotton Valley beds comprise two units of formational rank, and proposes that Cotton Valley be raised to the rank of a group that will include these two formations.

The Cotton Valley group, then, includes the rocks lying stratigraphically between the base of the Hosston formation (Travis Peak of East Texas petroleum geologists) and the top of the Buckner formation, or the top of the Smackover formation in areas where the Buckner is not recognizable. It consists of the Schuler formation above and the Bossier formation below.

The deep structural features of the area are shown by contours on the top of the Cotton Valley group (Fig. 1). These include (1) the East Texas basin of northeastern Texas, (2) the Sabine uplift of northwestern Louisiana and adjacent East Texas, (3) the monoclinal area of south-central Arkansas and north-central Louisiana, which is bounded on the north by (4) a system of graben-type faults, and (5) the Monroe platform of northeastern Louisiana.

BOSSIER FORMATION

Definition.—The Bossier formation includes the marine, dark gray to black shale and sandstone, and the shoreward equivalents of these rocks beneath the Schuler formation and above the Buckner formation or its basinward equivalent. The formation is named from Bossier Parish, of northwestern Louisiana and the type locality is the Bellevue oil field in east-central Bossier Parish (Fig. 2).

Distribution.—In northern Louisiana, the Bossier formation has been found by drilling in Caddo, Bossier, Claiborne, Lincoln, Union, Morehouse, East Carroll, and West Carroll parishes. On the south, wells have not penetrated deep enough to reach it. In southern Arkansas, the Bossier is present in, roughly, the southern half of Miller, Lafayette, Columbia, and Union counties. On the east, the occurrence of the Bossier has not been defined by drilling. On the north, in southern Arkansas, the Bossier is absent probably in large part as a result of pre-Schuler erosion (Fig. 2). In eastern Texas, the Bossier is present in Panola County, adjacent to Louisiana (Fig. 7). On the northwest, a well drilled in the Talco field of northeastern Franklin County, may have encountered a thin section of Bossier. Elsewhere in the East Texas basin, there is no definite knowledge of the Bossier formation, but it may underlie most of the East Texas basin. A deep well in Clarke County, western Alabama, probably encountered rocks of Bossier age.

Thickness.—The Bossier formation varies in thickness from a knife-edge where it is overlapped by the Schuler formation to almost 2,000 feet on the flank of the North Lisbon field in east-central Claiborne Parish, Louisiana. At the type locality in the Bellevue oil field, Bossier Parish, the Bossier formation is

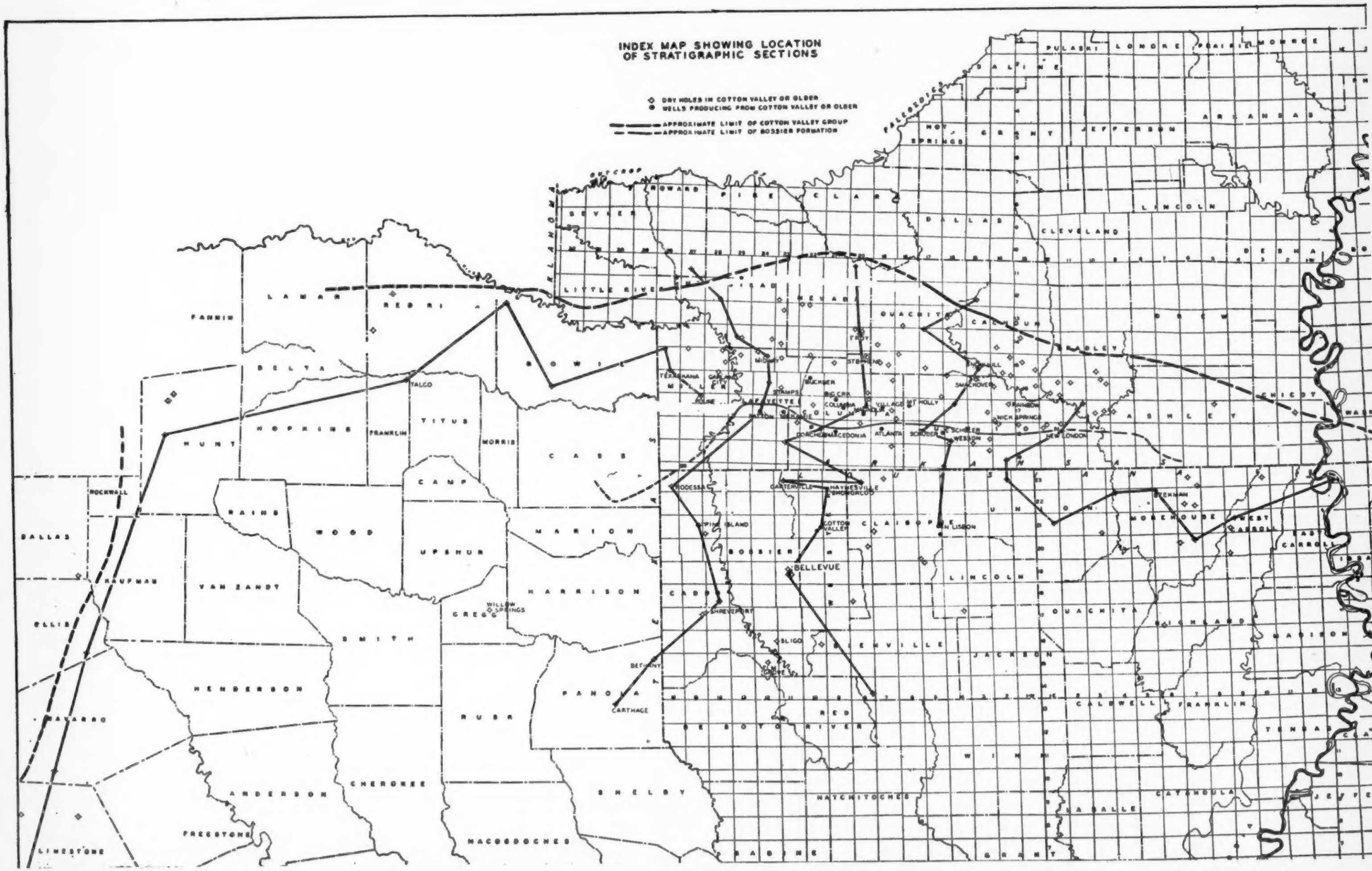


FIG. 2.—Index map showing location of stratigraphic sections.

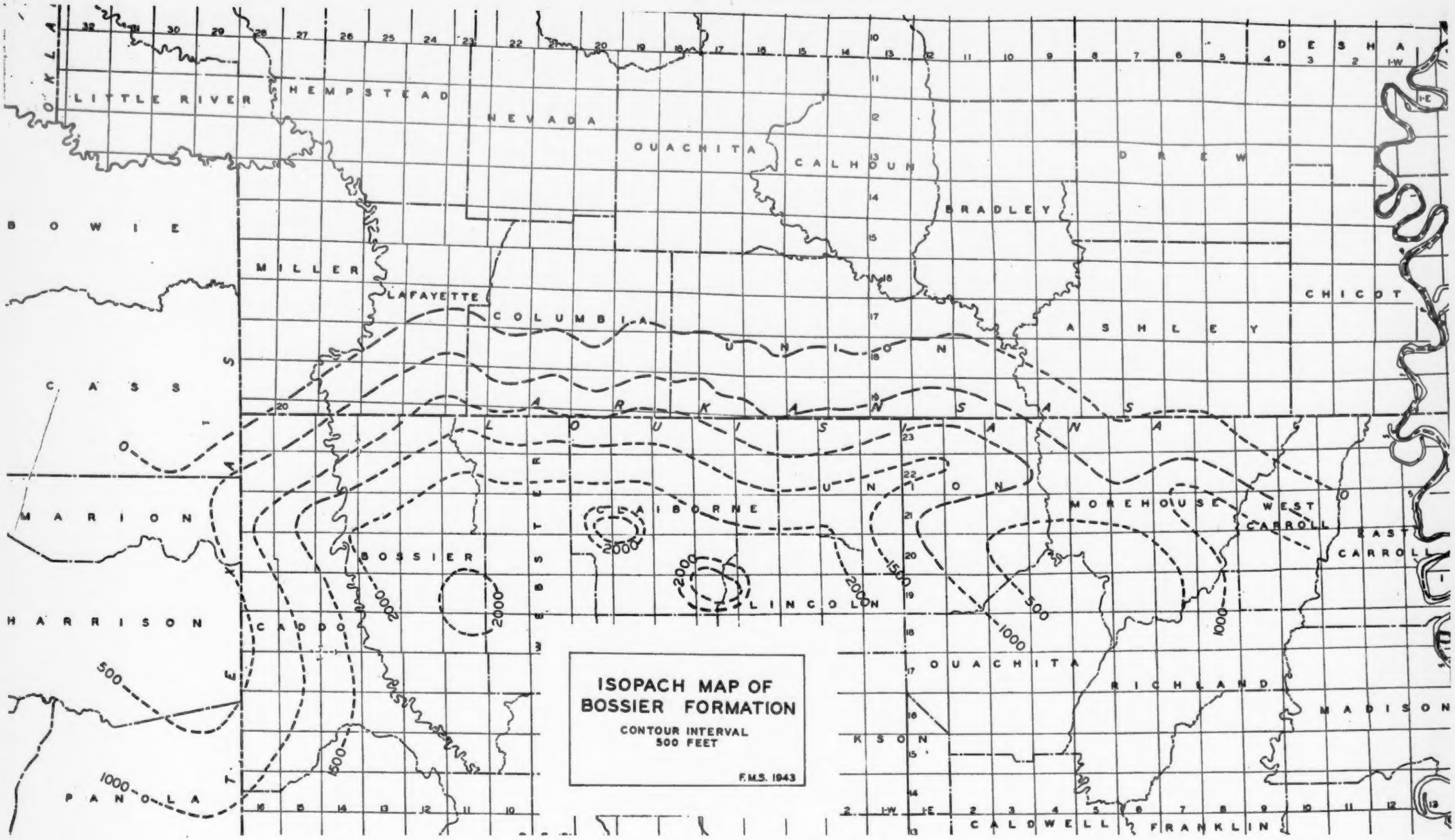


FIG. 3.—Isopach map of Bossier formation.

1,635 feet thick. In contrast with the relative uniformity in thickness of the Schuler formation, the thickness of the Bossier formation in northern Louisiana and southernmost Arkansas is highly variable. In general, it thickens southward, at an average rate of about 125 feet per mile. North of T. 21 N., Louisiana, the Bossier probably has undergone pre-Schuler erosion, as explained on following pages, so that its original thickness can not be determined. Consequently, the original rate of basinward thickening of the Bossier was much less than the figure given. The reader is referred to the Bossier isopach map (Fig. 3) for known thicknesses of the formation.

Lithologic character.—At the type locality in the Bellevue oil field, the Bossier consists almost entirely of dark gray to black, calcareous, ammonite-bearing shale, with a few thin layers of dark, argillaceous limestone, and, near the top, a little sandstone (Fig. 4). In this section, the Bossier passes downward, imperceptibly, into interbedded dark argillaceous limestone and shale which may be the offshore equivalent of the Buckner red shale and anhydrite formation. Below these probable Buckner equivalents are dark argillaceous limestones which represent the Smackover formation.

In wells in Caddo Parish, Louisiana, at Rodessa (Norton's Payne No. 1, Sec. 27, T. 23 N., R. 16 W.) and at Pine Island (Stanolind's Dillon Heirs No. 1, Sec. 14, T. 21 N., R. 15 W.), in Panola County, Texas, at Bethany (Texas' Adams No. C-1, Cox Survey), and in southeastern Claiborne Parish, Louisiana, at Sugar Creek (Union Producing Company's Brownfield No. 2, Sec. 5, T. 19 N., R. 5 W.), the Bossier formation is made up almost entirely of dark gray to black shale, as at the type locality. A deep test in the old Homer oil field of eastern Claiborne Parish, Louisiana, Frankel Bros.' Muslow No. 1, Sec. 30, T. 21 N., R. 7 W., encountered oölitic limestone in the lower part of the Bossier formation.

On the north and east, the Bossier changes lithologically. In the North Lisbon field of east-central Claiborne Parish, Louisiana, and in the Haynesville field in northwestern Claiborne Parish (Figs. 4 and 5), the lower half to two-thirds of the Bossier consists of mostly fine-grained white and gray, in part fossiliferous, calcareous sandstone, interbedded with dark fissile shale. The upper third to half of the Bossier in these two localities is dark fissile shale interbedded with thin layers of limestone.

On the north, in southern Arkansas, the Bossier consists principally of fine- to medium-grained, gray and white sandstone, which contrasts with the unconformably overlying coarser, reddish sandstones of the basal Schuler formation (Figs. 4 and 5). Interbedded with the Bossier sandstones in southern Arkansas are shales which are for the most part dark, but in southeastern Lafayctte County, Arkansas, in the McAlester's Jeffus No. 1, Sec. 4, T. 19 S., R. 23 W., there is some red shale in the lower Bossier formation (Fig. 4).

East of Claiborne Parish, Louisiana, toward the Monroe platform, the Bossier formation passes by interfingering into redbeds probably non-marine in character (Fig. 6). Where the Bossier formation consists entirely of redbeds as in the

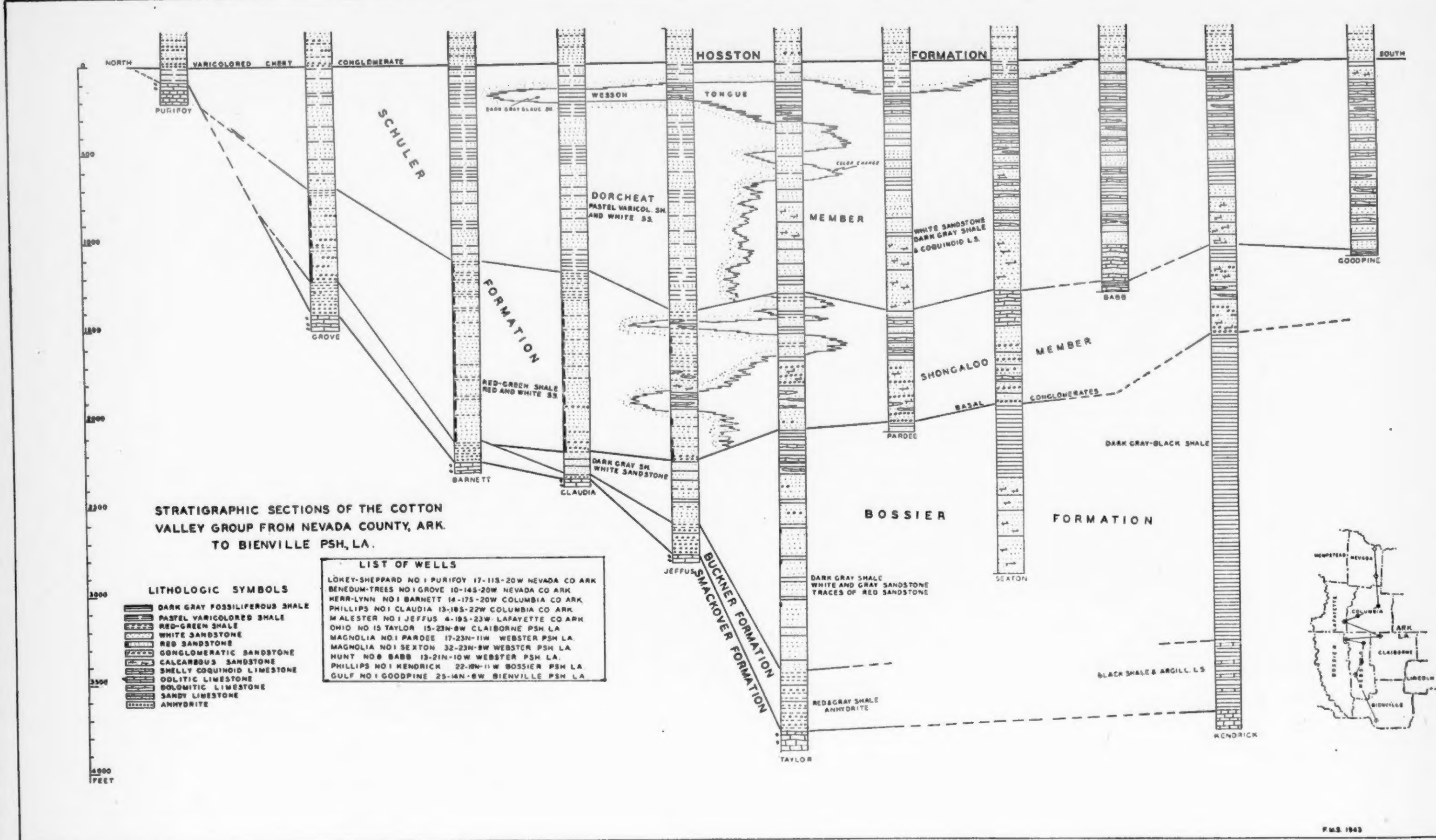


FIG. 4. —Stratigraphic sections of Cotton Valley group from Nevada County, Arkansas, to Bienville Parish, Louisiana.

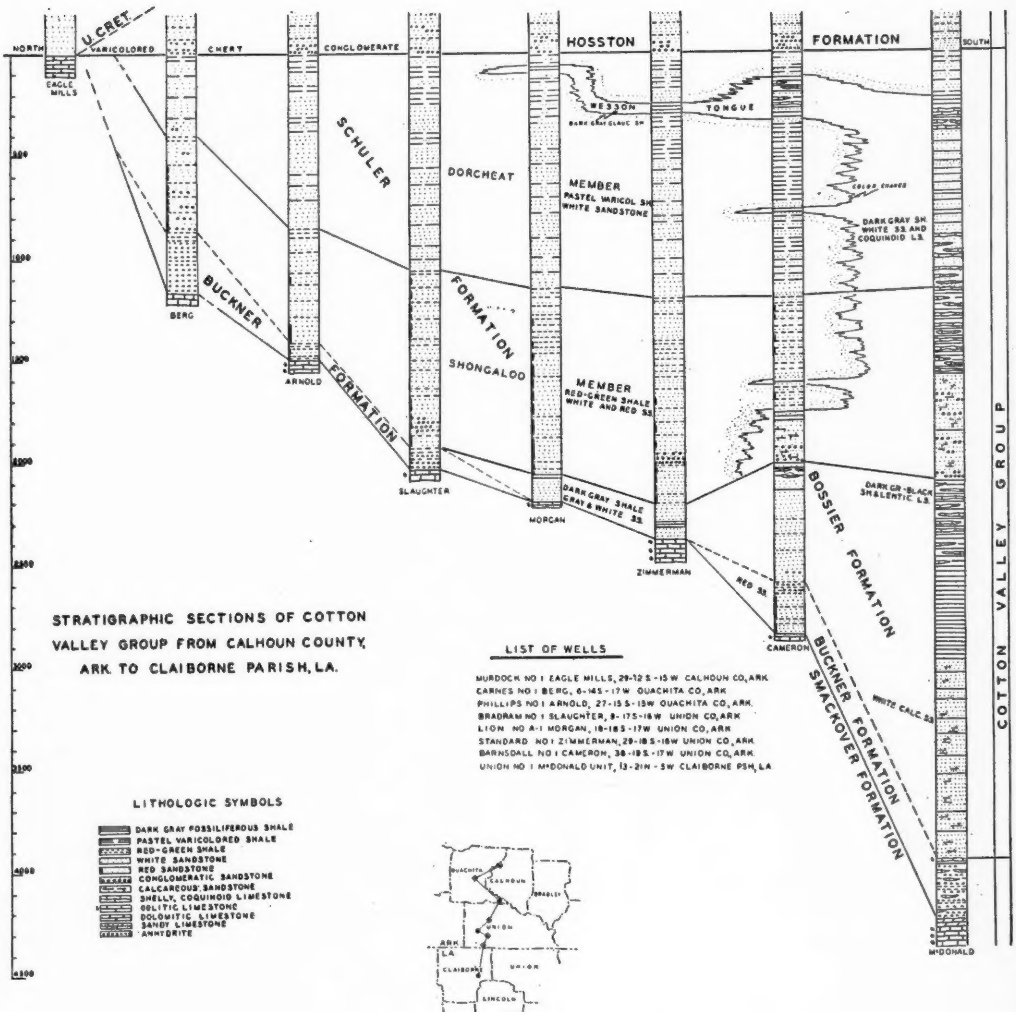


FIG. 5.—Stratigraphic sections of Cotton Valley group from Calhoun County, Arkansas, to Claiborne Parish ,Louisiana.

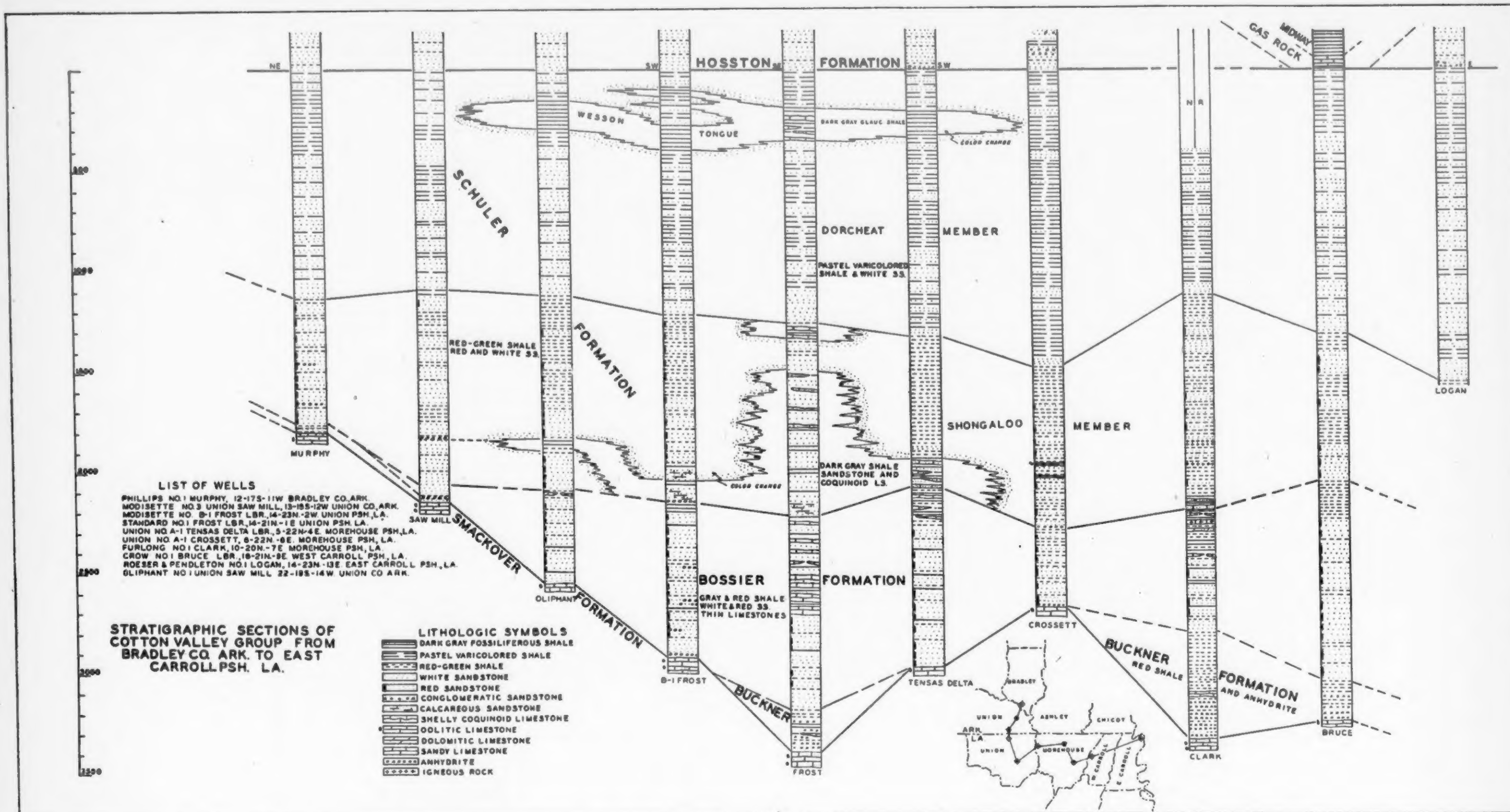


FIG. 6.—Stratigraphic sections of Cotton Valley group from Bradley County, Arkansas, to East Carroll Parish, Louisiana.

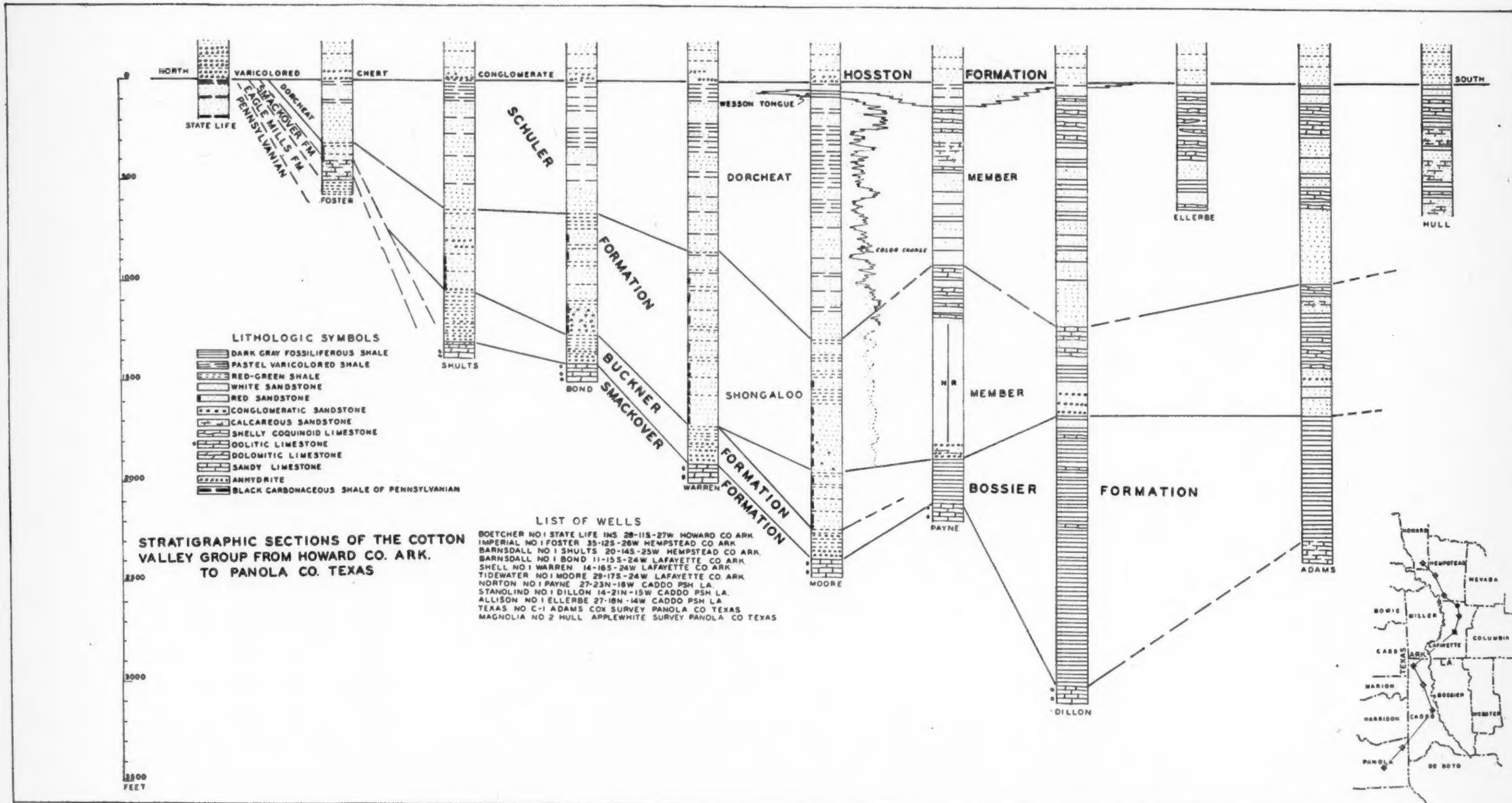


FIG. 7.—Stratigraphic sections of Cotton Valley group from Howard County, Arkansas, to Panola County, Texas.

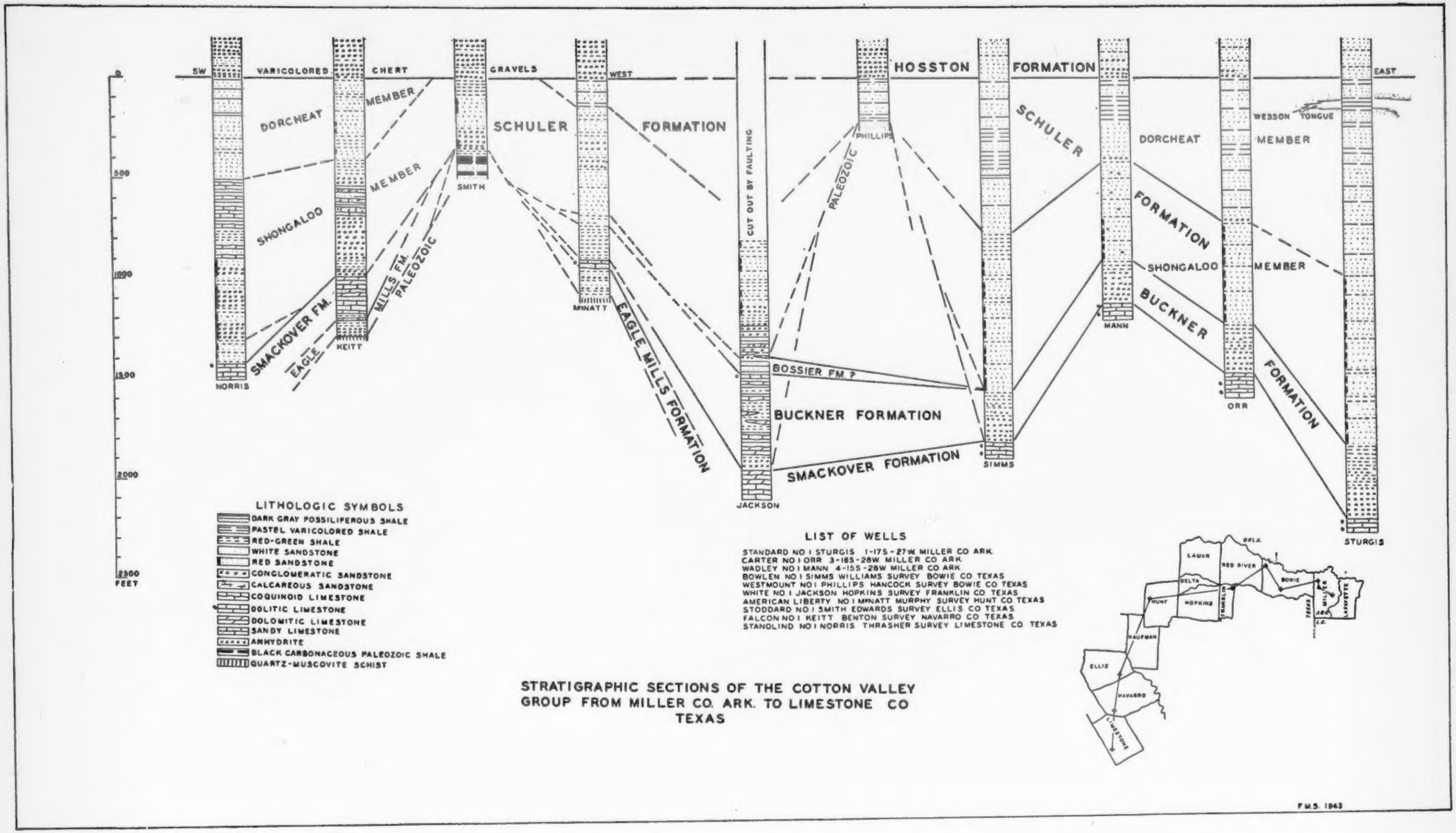


FIG. 8.—Stratigraphic sections of Cotton Valley group from Miller County, Arkansas, to Limestone County, Texas.

Crow's Bruce Lumber Company No. 1, Sec. 16, T. 21 N., R. 9 E., West Carroll Parish, Louisiana, the contact between the Bossier formation and the overlying Schuler formation is difficult to determine, and one must resort to parallelism to determine the top of the Bossier. It is believed that detailed petrographic study of the Cotton Valley beds would be valuable in this area.

Aside from the occurrence of Bossier shales in Panola County, there is no certain knowledge of the formation in East Texas. It is probable, however, that the Bossier may be present in most of the East Texas basin, but it has not been reached by drilling. A deep test in the Talco field of northeastern Franklin County (White and Vaughn's Jackson No. 1, Hopkins Survey) encountered about 75 feet of section which may represent the Bossier. This consists of fine-grained gray sandstone and dark shale beneath conglomeratic sandstones and limestones of the Schuler formation and above a well developed and exceptionally thick Buckner section (Fig. 8).

There is little knowledge of the Bossier formation east of the Mississippi River. The Union Producing Company's Waite No. 1, a wildcat in Sec. 27, T. 8 N., R. 1 W., Clarke County, Alabama, penetrated the Cotton Valley group. A section of fine- to coarse-grained red sandstones and red shales from 10,160 to 11,660 feet may represent the Bossier formation. These rocks are overlain by conglomerate beds which are thought to represent the Shongaloo member of the Schuler formation.

The type section of the Bossier formation follows.

TYPE SECTION OF BOSSIER FORMATION

Phillips Petroleum Company's Kendrick No. 1, C., NE., SW. Sec. 22, T. 19 N., R. 11 W., Bossier Parish, Louisiana, Bellevue Field Deep Test

Lithology	*Depth (Feet)*	*Thickness (Feet)*
COTTON VALLEY GROUP Schuler Formation (Lower Part)		
Sandstone; white and gray, fine- to coarse-grained, conglomeratic, calcareous, fossiliferous, with interbedded coquinoid, in part sandy, limestone and silty gray calcareous shale. Pebbles of quartz and dark gray chert, well rounded and up to an inch in diameter. Imlay identified *Pseudomonitis durangensis* from core 6,367–6,382 and *P. durangensis* and *Corbicella*? sp. from core samples at 6,488 feet	6,330–6,505	175
Bossier Formation		
Shale; very dark gray, silty, with pyrite clusters and trace very fine gray sandstone	6,515	10
Sandstone; light gray, fine tight calcareous	6,525	10
Shale; dark gray to black silty micaceous carbonaceous and dark gray calcareous siltstone, fossiliferous	6,582	57
Sandstone; light gray, silty, calcareous fine-grained with dark grains	6,600	18
Shale; dark gray to black, silty calcareous, with small involute Foraminifera	6,815	215
Shale; dark gray to black, silty, calcareous, and dense argillaceous dark gray limestone with Foraminifera as above; trace fine white calcareous sandstone	6,955	140
Shale; dark gray to black silty, calcareous with vein calcite which is in part asphaltic. Foraminifera, few Ostracoda, *Astarte* sp., gastropods	7,440	485

Lithology	Depth (Feet)	Thickness (Feet)
Shale; dark gray to black, silty with vein calcite and dark argillaceous limestone, Foraminifera, *Astarte* sp., Bryozoa. Imlay has identified following species from cores: *Metahaploceras* cf. *M. nereus* (Fontannes), 7,654–7,664; *Idoceras* cf. *I. durangense* Burckhardt, *Idoceras* cf. *I. lorioli* Burckhardt, *Glochiceras* cf. *C. fialar* (Oppel), *Taramelliceras*? sp., *Haploceras* sp., *Physodoceras*? sp., *Lamellaptychus* sp., *Pteroperna*? sp., Pelecypods on carbonized material, fish scales, fish skull bones, 8,048–8,063. This core of black shale had faint hydrocarbon odor on fresh break	8,140	700
Buckner Formation		
Shale; black, calcareous	8,230	90
Shale; dark gray to black, grading downward into dense to finely crystalline argillaceous limestone. Imlay identified following species from cores: *Ataxioceras* sp. *Idoceras* sp. *Astarte* sp., *Astarte brevicola* Cragin, fish scale, 8,279–8,294; *Idoceras* (*Sub-nebrodites*)? cf. *I. planula* (Zieten), *Ataxioceras? sp.*, 8,377–8,392	8,627	397
Smackover Formation		
Limestone; dark gray to black, silty, argillaceous; trace of oölitic structure at top becomes dolomitic and banded toward base. Fossils identified by R. W. Imlay: *Discosphinctes* cf. *D. virgulatus* (Quenstedt), *Discosphinctes* cf. *D. lucingensis* (Choffat), *Dichotomosphinctes*? cf. *D. plicatilis* (De Riaz), *Lamellaptychus* sp., *Lima* (*Plagiostoma*) sp., rhynchonellid brachiopod, fish scale. (Core, 8,741–8,756)	9,038	411

Stratigraphic relationships.—South of T. 21 N. in Louisiana, the Bossier formation may be conformably overlain by the Schuler formation. Further drilling, however, is necessary to make this relationship certain. North of T. 21 N., Louisiana, as far as the limit of the Bossier in southern Arkansas, the Schuler rests with probable angular unconformity on the Bossier (Figs. 4, 5, and 9). In other areas, the relationship between the Schuler and the Bossier is not clear.

The relationship between the Bossier formation and the underlying Buckner formation is not well understood. In certain areas, the Bossier rests directly on the Smackover limestone. In the Schuler oil field, a thin layer of conglomerate was cored at the base of the Jones sand (basal Bossier) which rests on Smackover limestone.[11] The same condition exists in the small Beekman field in north-central Morehouse Parish, Louisiana.[12] In other areas, there is full development of the Buckner beneath lower Bossier sandstones. The writer knows of no definite evidence of disconformity between the Bossier and Buckner formations where these formations are in contact. A detailed study of Smackover and Buckner stratigraphy is necessary, however, before the relationships of these two formations to the Bossier can be adequately determined.

Paleontology.—R. W. Imlay[13] has identified the following megafossils from cores in the Bossier formation: *Metahaploceras* cf. *M. nereus* (Fontannes), *Idoceras* cf. *I. durangense* Burckhardt, *Idoceras* cf. *I. lorioli* Burckhardt, *Idoceras* cf. *I. complanatum* Burckhardt, *Glochiceras* cf. *G. fialar* (Oppel), *Taramelliceras*? sp.

[11] W. B. Weeks, personal communication.

[12] C. W. Alexander, personal communication.

[13] R. W. Imlay, *op. cit.* (1943), pp. 1470–72. (The writer here assigns these fossils to the Bossier formation.)

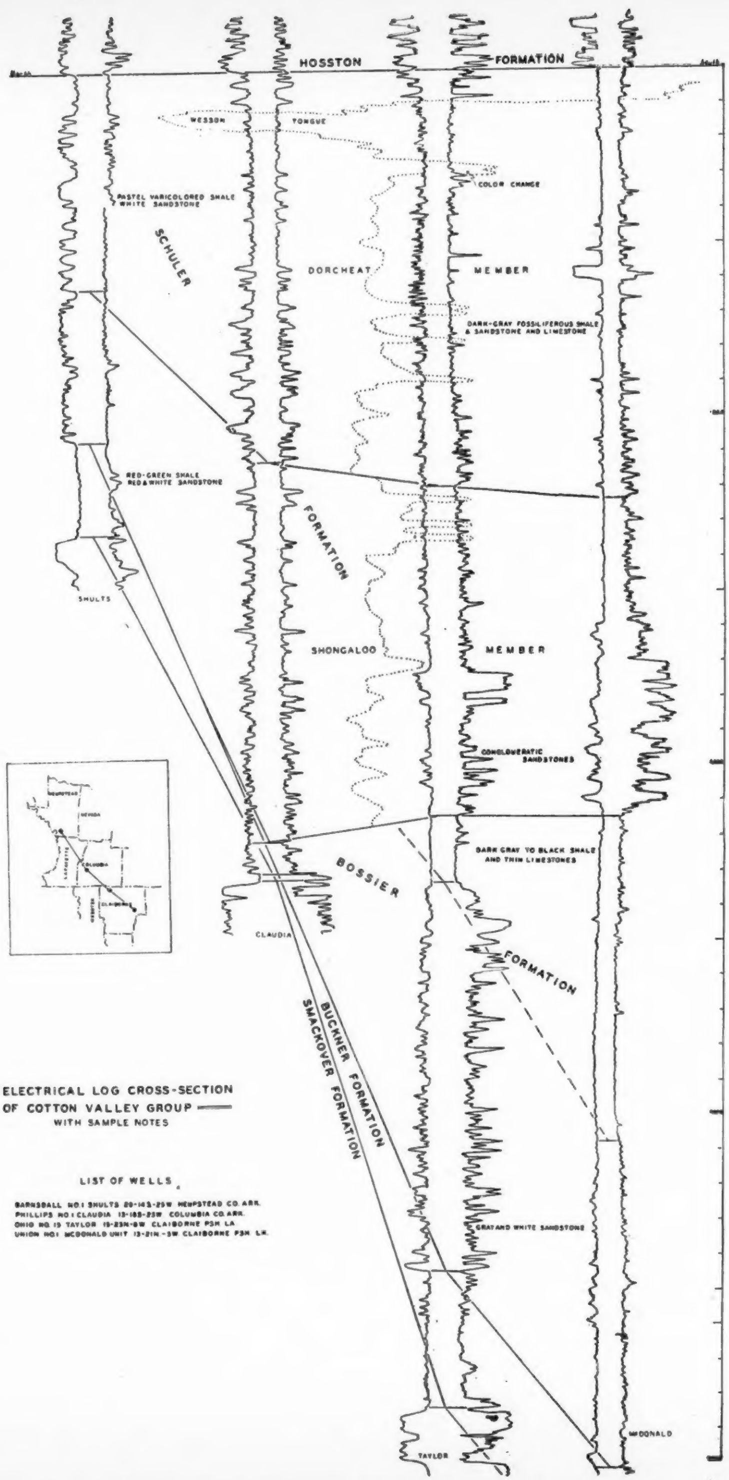


Fig. 9.—Electrical log cross section of Cotton Valley group.

Haploceras sp., *Physodoceras*? sp., *Lamalleptychus* sp., *Pteroperna* sp., *Aulacomyella* sp. The microfauna of the Bossier formation has not been described or completely studied. There are several species of Foraminifera and Ostracoda in the writer's collections.

Age and correlation.—Imlay[14] believes that the foregoing assemblage of megafossils furnishes a correlation with the middle Kimmeridgian of Mexico.

SCHULER FORMATION

Definition.—The updip, essentially redbed part, of the Cotton Valley has been called the Schuler facies by Weeks,[15] Hazzard,[16] and Imlay.[17] It is proposed here that the name be redefined as Schuler formation to include the nearshore or non-marine pastel, and red-green shales, sandstones, and basal conglomerates and the offshore equivalents of these rocks, which are dark gray fossiliferous shales, limestones, sandstones, and basal conglomerates, lying stratigraphically between the base of the Hosston formation and the top of the Bossier formation. The type locality is the Schuler oil field in Union County, Arkansas.

As in previous usage of "Schuler" the present definition includes practically all the Cotton Valley beds in southern Arkansas, as the underlying Bossier formation extends only a short distance north of the Arkansas-Louisiana state line (Fig. 2).

Distribution.—In southern Arkansas, the Schuler formation is present in Miller, Lafayette, Columbia, and Union counties, in the southern half of Bradley, Calhoun, and Hempstead counties, the southern two-thirds of Ouachita and Nevada counties, the southern third of Little River County, and is probably present beneath most of Ashley County and the southern half of Chicot County. North of these limits, the entire Cotton Valley group is absent due to pre-Upper Cretaceous erosion. The northern limit of the Cotton Valley in southern Arkansas is shown in Figure 2 which is modified after illustrations by Weeks[18] and Imlay.[19]

In northern Louisiana, the Schuler formation has been encountered by drilling only in Caddo, Bossier, Webster, Claiborne, Union, Morehouse, West Carroll, East Carroll, Richland, Lincoln, and Bienville parishes, but probably extends much farther south.

In East Texas, the Schuler formation probably underlies the entire East Texas basin, but at such great depths that only a few wells have reached it. On the east side of the basin, it has been identified in Panola County, and in Gregg County. On the north side of the basin it is present in Bowie County and in the southern

[14] *Ibid.*, p. 1471.

[15] W. B. Weeks, *op. cit.*, pp. 60, 66.

[16] R. T. Hazzard, *op. cit.*, p. 156.

[17] R. W. Imlay, *op. cit.*, p. 25.

[18] W. B. Weeks, *op. cit.*, p. 957.

[19] R. W. Imlay, *op. cit.*, plate XIV.

two-thirds of Red River County. It has been found in northwestern Hunt County, but its limits on the northwestern flank of the basin are not certainly known. It may be present in eastern Ellis County and in the eastern two-thirds of Navarro and Limestone counties. The southernmost well in East Texas to encounter Cotton Valley is in southwestern Limestone County. Figure 2 shows the approximate limits of the Cotton Valley in East Texas.

A deep well on the Jackson uplift in eastern Hinds County, Mississippi, penetrated pre-Upper Cretaceous rocks which Monroe[20] assigned to the Comanche. The writer and others believe that the lower part of this well penetrated the Cotton Valley (Schuler formation). A deep well in Scott County, Mississippi, probably penetrated the uppermost Schuler beds. A well recently drilled in Sec. 28, T. 5 N., R. 13 E., Newton County, Mississippi, encountered a thick section of limestone beneath basal Comanche conglomerates and separated from the conglomerates by layers of interbedded variegated shale with siderite and reddish limestone. Part of this section may be Cotton Valley in age. Rocks which probably represent the entire Cotton Valley group have been found in a wildcat drilled in Clarke County, western Alabama. Elsewhere, east of the Mississippi River, there is no certain information on the Cotton Valley rocks.

Thickness.—The isopach map of the Schuler formation (Fig. 10) shows the approximate thickness of the Schuler formation in southern Arkansas, northern Louisiana, and northeastern Texas. In general, the Schuler formation in southern Arkansas thickens southward from the line of its pre-Upper Cretaceous truncation at the rate of about 50 feet per mile. The thinnest section of Schuler noted is in Lokey-Sheppard's Purifoy No. 1, Sec. 17, T. 11 S., R. 20 W., Nevada County, Arkansas, where it is only 47 feet thick. How much Schuler has been removed by pre-Gulf erosion in this northern area is uncertain, but judged from the northward thinning within the Schuler, removal of beds may not have exceeded 200–300 feet.

The Schuler formation attains its greatest known thickness in southern Columbia and Union counties, Arkansas, and in northern Union and north-central Morehouse parishes, Louisiana, where it is at least 2,300 feet thick. South of these areas in northern Louisiana, the formation thins gradually. In southeastern Claiborne Parish, in the Sugar Creek field, the Schuler is only a little more than 1,200 feet thick. In southwestern Lincoln Parish, at Simmsboro, it is only about 1,400 feet thick.

Caution must be exercised, however, in interpreting Schuler thickness in northern Louisiana on the basis of present information. Most of the wells drilled to the Cotton Valley in this area have been on prominent domal structures. Some of the present-day structural uplifts may also have been positive areas during Schuler time resulting in a thinner section over the tops of the structures than in surrounding areas.

[20] W. H. Monroe and H. N. Toler, "The Jackson Gas Field and the State Deep Test Well," *Mississippi Geol. Survey Bull. 36* (1937).

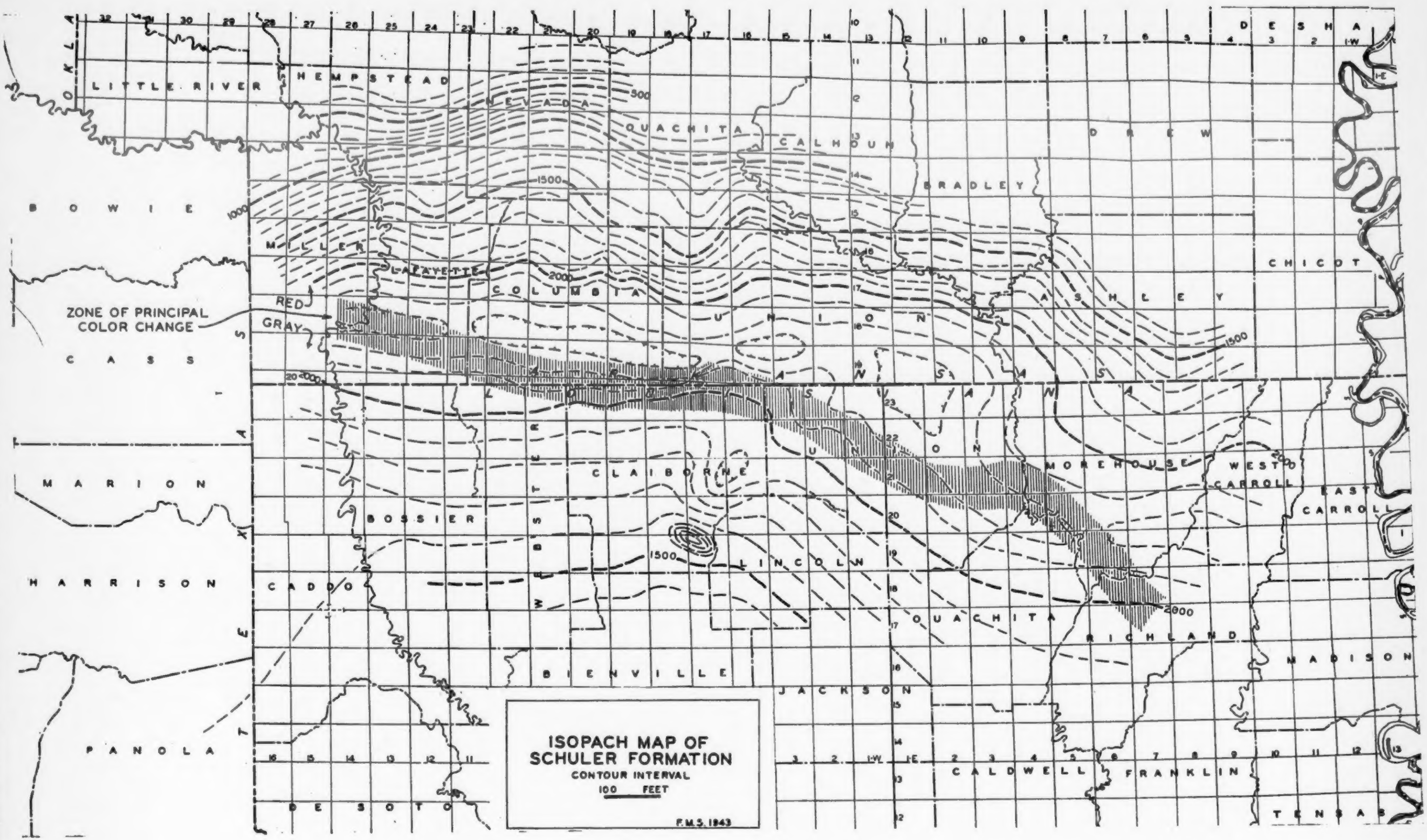


FIG. 10.—Isopach map of Schuler formation.

Facies of Schuler formation and principal subdivisions.—The Schuler formation includes two lithologic facies differentiated mainly by colors. Weeks, summarizing the conclusions reached by geologists in the area, wrote that the (nearshore) varicolored and red shales and sandstones beneath the Travis Peak red shales and coarse sands in the Schuler field of Arkansas were equivalent to the (offshore) fossiliferous shales, sandstones, and limestones beneath the Travis Peak in the Cotton Valley field and other areas of northern Louisiana.[21] These color changes are indicated in Figures 4–10.

The Schuler formation in southern Arkansas may be divided into two members. The upper member, herein named the Dorcheat, includes a little more than half the formation and attains a thickness of more than 1,200 feet in its fullest development. It is composed principally of pastel, varicolored shales or claystones, siltstones, and white sandstones. Marine fossils have not been observed by the writer except in a thin tongue of dark gray, partly glauconitic shale near the top of the member. In most places, the upper third of the Dorcheat member is predominantly shale and the lower two-thirds predominantly sandstone.

The lower member of the Schuler formation, herein named the Shongaloo member, attains a thickness in southern Arkansas of more than 1,000 feet, but averages thinner than the overlying Dorcheat member. In southern Arkansas, it consists of red and red-green shales of darker color than the Dorcheat shales, of red and white sandstones, and of conglomerates that are widespread in its lower part.

Basinward in northern Louisiana, the two members of the Schuler formation pass into dark gray, shell-bearing shales, limestone, and sandstone, but conglomerates persist in the lower part of the Shongaloo member. This color change takes place very near the Arkansas-Louisiana state line. The updip facies of both members of the Schuler formation will hereinafter be referred to as the nearshore facies, and the basinward definitely marine facies will be referred to as the offshore facies. The offshore Schuler rocks were deposited in a shallow-water marine environment that supported abundant oysters and other life. The nearshore Schuler rocks were deposited in a fresh- or brackish-water environment which probably was unfavorable to bottom-dwelling organisms.

In the area affected by the Monroe uplift in eastern Union, Morehouse. West Carroll, and East Carroll parishes, Louisiana, the Schuler formation is characterized by the nearshore facies. Elsewhere in Louisiana, the Schuler consists predominantly of the offshore facies. In East Texas, both members of the Schuler are recognizable, but the facies relationships are not clear in this area, because only a few wells have penetrated the Cotton Valley there. The type section of the Schuler formation and some of the adjoining beds is here given.

[21] W. B. Weeks, *op. cit.*, p. 966. (The term Hosston has now been substituted for Travis Peak in southern Arkansas and northern Louisiana, but "Travis Peak" is still used by geologists in East Texas for the pre-Trinity? Cretaceous redbeds of the East Texas basin.)

Type Section of Schuler Formation, Nearshore Facies

Lion Oil Refining Company and Phillips Petroleum Company's Edna Morgan No. 1, C., NE., SW., Sec. 18, T. 18 S., R. 17 W., Union County, Arkansas

Lithology	*Depth (Feet)*	*Thickness (Feet)*
Hosston Formation (Basal Beds)		
Sandstone; white, coarse, conglomeratic, some interbedded red silty shale	5,325–5,385	60
COTTON VALLEY GROUP		
Schuler Formation		
Dorcheat Member (Nearshore Facies)		
Shale; pale gray, with streaks white siltstone	5,410	25
Sandstone; white, fine, angular, porous	5,417	7
Shale; pale, varicolored, trace siderite, streaks of siltstone	5,485	68
Sandstone; white, fine, angular, porous, pyritic	5,500	15
Shale; dark gray, glauconitic, with streaks of argillaceous siltstone (herein named Wesson tongue), fossiliferous	5,520	20
Sandstone; white, very fine to fine-grained, silty, carbonaceous	5,535	15
Shale; dark gray, with sandy dolomitic streaks	5,550	15
Sandstone; fine, porous with oil stain, some interbedded pale gray shale	5,560	10
Shale; pastel, varicolored, with brown and reddish brown siderite, streaks of white siltstone	5,750	190
Sandstone; white, fine, porous to silty	5,760	10
Shale; pastel, varicolored, with streaks of sandstone	5,795	35
Sandstone; white, fine, porous, showing of oil	5,825	30
Shale; pastel, varicolored, siderite, streaks of siltstone	5,925	100
Sandstone; white, fine, angular, porous	5,940	15
Shale; pastel, varicolored	5,980	40
Sandstone; white, fine, angular, porous	5,990	10
Shale; pastel, varicolored	6,000	10
Sandstone; white, fine, angular, porous	6,015	15
Shale; pastel, varicolored	6,030	15
Sandstone; fine, white, angular, porous	6,055	25
Shale; pastel, varicolored	6,060	5
Sandstone; fine, white, angular, porous, shaly	6,080	20
Shale; pastel, varicolored	6,100	20
Sandstone; white, fine, lignitic	6,125	25
Siltstone; white, lignitic	6,150	25
Shale; pastel, varicolored	6,190	40
Sandstone; white, fine, angular, silty to porous, slight oil stain	6,225	35
Shale; pastel, varicolored, sideritic	6,235	10
Sandstone; white, porous, in part dolomitic, carbonaceous	6,270	35
Shale; pastel, varicolored	6,315	45
Sandstone; white, fine, dolomitic	6,325	10
Shale; pastel, varicolored	6,335	10
Sandstone; white, fine, angular, porous, carbonaceous, pyritic	6,370	35
Shale; pastel, varicolored	6,405	35
Sandstone; white, fine, silty to porous	6,445	40
Shongaloo Member (Nearshore Facies)		
Shale; red, silty	6,460	15
Sandstone; white, silty, tight, oil stain	6,490	30
Shale; red, silty	6,510	20
Sandstone; white, porous, silty	6,525	15
Shale; red, silty, sandy, carbonaceous, with streaks argillaceous sandstone	6,600	75
Sandstone; white, very fine to fine, with nodular dolomite	6,610	10
Shale; red, silty, with dolomite nodules	6,630	20
Sandstone; white, fine, lignitic	6,635	5
Shale; red, silty, with dolomite nodules, streak of red, argillaceous, fine sandstone	6,675	40
Sandstone; white, fine, slightly porous, lignitic, streaks red shale	6,750	75
Shale; red, silty, with streaks of fine white silty sand, and nodular dolomite	6,845	95

Lithology	*Depth (Feet)*	*Thickness (Feet)*
Sandstone; white, medium-grained, fairly porous, asphaltic	6,855	10
Shale; red, silty, with streaks of fine red, argillaceous sandstone	6,905	50
Sandstone; white, medium-grained with dark chert grains, streaks red shale, asphaltic	6,920	15
Shale; red, silty, streaks of fine red and white sandstone	6,990	70
Sandstone; red, fine- to medium-grained, with nodular dolomite, in part carbonaceous	7,145	155
Shale; red, silty and dark gray interbedded	7,180	35
Sandstone; red, medium-grained, carbonaceous, with dark chert grains, some interbedded red shale	7,275	95
Shale; red, silty, some dark gray shale, interbedded	7,290	15
Sandstone; red, medium-grained carbonaceous	7,335	45
Shale; red, silty	7,340	5
Sandstone; red, medium-grained	7,355	15
Shale; red, silty	7,375	20
Sandstone; red, fine- to medium-grained, some white sandstone interbedded	7,475	100
Bossier Formation		
Shale; dark gray, pyritic, with some interbedded very fine-grained white sandstone	7,500	25
Sandstone; white and gray, fine-grained, oil stain (Jones producing sand)	7,575	75
Shale; dark, gray	7,585	10
Sandstone; light gray, fine-grained, oil stain, conglomerate at base in other wells (Jones producing sand)	7,600	15
Smackover Formation		
Limestone; dense, gray-brown	7,603	3
Shale; greenish gray, silty	7,604	1
Limestone; gray-brown, oölitic, tight to slightly porous. Total depth	7,686	82

Paleontology.—R. W. Imlay[22] has identified the following megafossils from rocks herein assigned to the offshore facies of the Schuler formation: *Nuculana* sp., *Exogyra* sp., *Gryphaea* sp., *Pseudomonotis durangensis* (Imlay), *Astarte* cf. *A. breviacola* Cragin, *Tencredia louisianensis* Imlay, *T. texana* Imlay, *Quenstedtia* sp., *Protocardia* sp. In addition, abundant Ostracoda and a few Foraminifera occur in the Schuler, but have not been adequately studied. L. W. Calahan[23] has identified the following microfossils: *Haplophragmoides* 2 spp., *Ammobaculites* sp., *Quinqueloculina* sp., *Guttulina* sp., *Cythere* 3 spp., *Cytherella* sp., *Cytheridea* 2 spp., *Loxoconcha* sp., *Paracypris* sp., *Jonesina* sp.

Age and correlation.—The Schuler formation rests unconformably on the Bossier formation from which Imlay has identified late Kimmeridgian fossils.[24] The Schuler formation contains pelecypods of definite Upper Jurassic age and probably represents the Portlandian and Tithonian stages according to Imlay.[25]

[22] R. W. Imlay, "Jurassic Fossils from Arkansas, Louisiana, and East Texas," *Jour. Paleon.*, Vol. 15, No. 3 (May, 1941), pp. 256–77.

[23] L. W. Calahan, "Diagnostic Fossils of the Ark-La-Tex Area," *Shreveport Geol. Soc. Guide Book Fourteenth Annual Field Trip* (1939), pp. 36–56.

[24] R. W. Imlay, written communication.

[25] *Ibid.*

DETAILED DESCRIPTION OF SCHULER MEMBERS

Shongaloo Member

Definition.—The Shongaloo member includes the nearshore facies of red and red-green shales, red and white sandstones and basal conglomerates, and the basinward offshore equivalents of these rocks, which are dark gray fossiliferous shales, shelly limestones and sandstones, and basal conglomerates, lying beneath the Dorcheat member.

The type locality is the town and oil field of Shongaloo, Webster Parish, Louisiana (Fig. 2). The discovery well for the deep (Cotton Valley) production in the Shongaloo field is the Magnolia's Sexton No. 1, Sec. 17, T. 23 N., R. 11 W. The principal producing bed in this field, the "Sexton" conglomeratic sandstone, occurs in the lower part of the Shongaloo member. The type section belongs to the offshore facies (Fig. 4).

Distribution.—The Shongaloo member is present in southern Arkansas, northern Louisiana, and northeastern Texas, but east of the Mississippi it has not been definitely recognized. It is overlapped by the Dorcheat member in northeastern Nevada County, Arkansas (Fig. 4), and in northwestern Bowie County, Texas (Fig. 8), probably because of its non-deposition. Additional drilling may further limit the Shongaloo member in this marginal area.

Thickness.—The Shongaloo member ranges in thickness from a feather-edge at its northern limit to more than 1,000 feet in parts of southern Columbia and Union counties, Arkansas, and in eastern Morehouse Parish, Louisiana. It thins southward in Louisiana and at Bellevue in east-central Bossier Parish is only 500 feet thick. In East Texas, its thickness averages about 600 feet, but attains 900 feet in southern Limestone County.

Lithologic character of nearshore facies.—In southernmost Arkansas, the Shongaloo member consists typically of an upper shale unit including some interbedded sandstone, and a lower sandstone unit including a minor amount of interbedded shale. However, updip the member becomes increasingly sandy and in most wells north of T. 15 S., Arkansas, it consists principally of sandstone (Figs. 4–9).

The sandstones of the nearshore facies of the Shongaloo are fine- to coarse-grained with interbedded conglomeratic layers. Individual beds are lenticular and can not be traced very far laterally. The sands are in part white and in part red, the latter color being due to a coating of ferric oxide on the grains. The thicker, more massive sandstone layers tend to be white in color, and the thinner layers tend to be red. In some wells, however, the sandstones of the entire member may be red or reddish. The quartz grains of the sandstones are angular to subangular and many have overgrowths of silica, but secondary cementation by silica is uncommon. The porosity of the sandstones varies according to the amount of silt or clay and the presence or absence of carbonate as a cementing material. The conglomeratic layers within the Shongaloo sandstones are composed of subangular to rounded fragments of quartz and gray and white chert mixed with finer-grain sizes of these minerals. The conglomerate layers are so erratically

distributed within the member that individual layers can not be traced very far. Many of the sandstone beds contain light green, clayey grains, flakes of chloritic material, and some muscovite mica.

The shale of the nearshore facies of the Shongaloo is principally brick red in color, but includes some interbedded green shale. The red color increases in amount updip. In some wells, a small amount of pastel, varicolored, ankeritic shale occurs in the upper part of the member, suggesting interfingering of the Shongaloo member with the overlying Dorcheat member.

Varicolored, nodular, argillaceous limestone and dolomite occur in the red and green shales of the Shongaloo member as thin irregular layers of red, yellow, and brown. No fossils have been observed.

Lithologic character of offshore facies.—The offshore facies of the Shongaloo member typically comprises two units. The upper half to two-thirds of the member consists of interbedded shale and limestone and minor amounts of sandstone. The lower third to half consists of sandstone, in part conglomeratic, and some interbedded shale and limestone.

The sandstones are light gray to white in color, in part calcareous, oyster-bearing, thick- to thin-bedded, fine- to coarse-grained, and partly conglomeratic. The grains are somewhat better rounded than those of the nearshore facies sandstones. Dark gray chert grains are present in some layers.

The conglomeratic layers consist of mostly well rounded pebbles of quartz and dark gray chert in a matrix of sandstone or shale. Typically (from core data) the pebbles are disseminated within the matrix rather than occurring in closely packed layers.

The shales are dark gray, fissile, in part sandy or silty, and include abundant oyster shells in some layers. Glauconite has been noted rarely in gray shales having irregular, rather than fissile, fracture. This irregular fracture is characteristic of the shales of the nearshore facies. In the zone of lateral transition from the nearshore facies to the offshore facies, occurs interfingering of red and green shale with dark gray, fissile, shell-bearing shale.

The limestones of the Shongaloo member may be sandy, argillaceous, thin-bedded, or may consist of an oyster shell coquina.

The type section of the Shongaloo member is here given.

TYPE SECTION OF SHONGALOO MEMBER

Magnolia Petroleum Company's Sexton Unit No. 1, SW., NW., SE. Sec. 32, T. 23 N., R. 9 W., Webster Parish, Louisiana; Shongaloo Field

Lithology	*Depth (Feet)*	*Thickness (Feet)*
COTTON VALLEY GROUP		
Schuler Formation		
Dorcheat Member (Offshore Facies) (Lower Part)		
Sandstone; white, fine-grained, calcareous	8,295–8,315	20
Limestone; gray, coquinoid, with oyster shells, interbedded with dark gray shale and calcareous sandstone	8,370	55
Sandstone; white, calcareous, shelly, fine-grained with streaks coquinoid limestone and dark gray shale	8,400	30

Lithology	Depth (Feet)	Thickness (Feet)
Shongaloo Member		
Shale; dark gray, fissile, calcareous, fossiliferous	8,455	55
Limestone; gray, coquinoid, probably thin-bedded, with thin interbedded layers of fine white calcareous sandstone and dark gray shale	8,885	430
Sandstone; white, medium- to coarse-grained, calcareous with dark gray chert grains (Roseberry sand of Shongaloo field)	8,905	20
Limestone; gray, coquinoid, sandy with thin layers of dark gray calcareous shale	8,990	85
Sandstone; white and light gray, medium- to coarse-grained with pebbles of rounded quartz (cored) some interbedded hard gray silty shale (Sexton distillate sand)	9,085	95
Limestone; gray-brown, coquinoid, with interbedded calcareous in part conglomeratic sandstone and dark gray silty shale and siltstone	9,180	95
Sandstone; white and light gray medium to coarse, in part conglomeratic with rounded quartz pebbles, calcareous, mostly low porosity	9,250	70
Shale; dark gray, fossiliferous, with beds of coquinoid limestone at top and base	9,355	105
Sandstone; white and light gray, medium- to coarse-grained, conglomeratic calcareous, with interbedded sandy gray limestone	9,450	95
Bossier Formation		
Shale; dark gray to black, silty, with thin layers of fine, white, tight sandstone and dense dark gray limestone	9,855	405
Sandstone; white and light gray, fine- to medium-grained, calcareous, with layers of gray limestone and dark gray shale. Total depth	10,461	606

Stratigraphic relationships.—The Shongaloo member is overlain conformably and in part gradationally by the Dorcheat member. The basal beds of the offshore facies of the Shongaloo member in most wells consists of conglomeratic sandstones that rest on the dark shales of the Bossier formation. South of T. 21 N., Louisiana, the Shongaloo-Bossier contact may be conformable, but farther north in Louisiana, it is probably unconformable. Northward in southern Arkansas, the Shongaloo rests unconformably on the Buckner or the Smackover formation.

Dorcheat Member

Definition.—The Dorcheat member of the Schuler formation is defined as including the nearshore, pastel, varicolored shales, and sandstones, and the equivalent offshore dark gray fossiliferous shales, sandstones, and limestones between the base of the Hosston formation and the top of the red-green shales, sandstones (nearshore facies), and marine rocks (offshore facies) of the Shongaloo member. The type locality is the Dorcheat oil field, Columbia County, Arkansas (Fig. 2).

Distribution.—The Dorcheat member is present throughout the known area of distribution of the Cotton Valley group in southern Arkansas and northern Louisiana. It is known to be present in the East Texas basin, except on the northern and western flanks of the basin, where it either merges with the Shongaloo member, or is absent by non-deposition, or by erosion, probably the latter. The Dorcheat pastel shales occur beneath the Jackson gas field in Hinds County, Mississippi, in the State of Mississippi's Fee No. 2, Sec. 25, T. 6 N., R. 1 E., at

the depth of 3,215 feet. The subdivisions of the Cotton Valley in this well have not been adequately determined, although drilling continued to 5,529 feet. It was probably reached by drilling in the Gulf Refining Company's (E. L. Martin) Newell Mineral Lease No. 1, Sec. 5, T. 6 N., R. 7 E., Scott County, Mississippi, at the depth of 10,310 feet. This well was abandoned at the total depth of 10,365 feet. The Union Producing Company's Waite No. 1, Sec. 27, T. 8 N., R. 1 W., Clarke County, Alabama, encountered red-green shales and red and white sandstones, probably Cotton Valley in age, between 8,870 and 11,660 feet and continued drilling to 12,399 feet. The top of the Buckner formation was found at 11,660 feet, Smackover limestone at 11,780 feet, and Eagle Mills red shale and salt at 12,372 feet. No evidence of rocks with definite Dorcheat lithology was observed in the cuttings from this well, but part of the section probably is equivalent to the Dorcheat.

Thickness.—In southern Arkansas, the Dorcheat beds thin gradually northward to the line of their truncation by pre-Gulf erosion. As there has been some pre-Hosston truncation of the Dorcheat in the northern counties of southern Arkansas, its original thicknesses can not be determined there, but erosion probably did not remove more than 200–300 feet of beds. In the Stewart's Fee No. 1, Sec. 31, T. 12 S., R. 23 W., Hempstead County, Arkansas, the Dorcheat member is only 75 feet thick, and is underlain by 245 feet of red shales and sandstones of the Shongaloo member, which rest on the Buckner formation. In the Lokey-Sheppard's Purifoy No. 1, Sec. 17, T. 11 S., R. 20 W., Nevada County, Arkansas, the Dorcheat member is only 47 feet thick and consists of pastel, varicolored shales and conglomeratic sandstones resting unconformably on the Smackover limestone (Fig. 4). The Dorcheat member attains its greatest thickness of 1,200 feet or more near the Arkansas-Louisiana state line and on the Monroe uplift, in Morehouse Parish, Louisiana, south of which area it thins gradually.

Lithologic character of nearshore facies.—The nearshore facies of the Dorcheat member, in its full development, consists of two principal units: the upper unit of interbedded shale and sandstone with shale predominating in most areas; the lower unit principally of sandstone with some interbedded shale (Figs. 4–9). The base of the Dorcheat member is determined in most wells at the base of this lower sand section, which also marks the top of the predominantly red shales of the underlying Shongaloo member.

The contact between the nearshore Dorcheat beds and the overlying Hosston is sharp and well defined in most places. The upper bed of the Dorcheat consists, in some places, of pastel, varicolored shale, and in other places, of white siltstone or fine white sandstone that contrasts sharply with the coarse, partly conglomeratic sandstones and red silty shales of the Hosston.

The sandstones of the Dorcheat member are mainly white or light gray, but some thin layers are red and argillaceous. The sandstones in most wells are fine-grained in the upper part of the member, but become increasingly coarser, downward. The quartz grains of most of the sandstones are angular to subangular in

shape. Well rounded grains are rare, although the coarser grain sizes tend to be better rounded than the finer sizes. In general, the thicker sandstone bodies are less argillaceous and silty than the thinner layers. Some beds of siltstone layers are argillaceous, but others consist of clean, snow-white quartz grains. Quartz and gray chert conglomerates occur in the updip parts of the member.

The most striking minor constituent of the Dorcheat sandstones, siltstones, and shales is a mineral identified as siderite, that consists of brown spheroidal pellets averaging about one millimeter in diameter. It is generally abundant in the upper half of the member, but is not necessarily present in the highest beds. It becomes less abundant downward and locally is entirely absent at the base. In the sandstones and siltstones it is either scattered irregularly or arranged in thin layers. In many sandstone beds the siderite pellets have a roughened surface caused by the impression of sand grains and some pellets enclose sand grains. The pellets occur singly, in attached pairs, or in botryoidal clusters. Thin sections show that the individual pellets consist of an inner, dense, cloudy core and an outer zone of radiating crystals (Fig. 11). The erratic occurrence of the siderite does not permit its use for detailed correlation from well to well.

Other easily recognizable minor constituents of the Dorcheat sandstones are volcanic ash, carbonized plant remains, dark gray chert (novaculite), and chloritic material. The volcanic ash appears as a flour-like, mostly white or gray material between quartz grains or in minute laminae. It is not common in the lower part of the member. Carbonized plant remains occur erratically in the sandstones as finely divided material. Novaculitic, dark gray chert grains occur in some sandstone layers, but their known distribution does not permit their use in detailed correlation. A green, flaky, micaceous mineral, probably chlorite, is present in the sandstones near the base of the member in many wells, but is rare above.

The shales of the Dorcheat member are typified by their variegated coloring and by their peculiar luster and fracture. The colors are mostly pale, pastel shales of gray, brown, lavender, and green, as differentiated from the darker-colored red and red-green shales of the Shongaloo member below. The Dorcheat shales fracture in irregular fragments, are rather soft and clayey, and have a dull luster due to very finely divided quartz. Siderite is the most abundant accessory mineral. For the most part, the Dorcheat shales appear to be poorly laminated. This type of lithology is not at all restricted to the Schuler formation. In the subsurface of the Gulf coastal area, shales or sandstones with similar appearance may be found in the basal Upper Cretaceous Lewisville of East Texas, southern Arkansas, and northern Louisiana, and in the Tuscaloosa of the southeastern states. The mineral siderite is also common in these beds. The same type of shale also occurs sparingly in the Comanche Paluxy and Hosston formations, with or without siderite. Sideritic, varicolored shales, very similar to those of the Schuler, occur in the Carboniferous Pottsville and Chester beds penetrated in wells in eastern Mississippi and Alabama. Petroleum geologists in other areas

will doubtless recall having seen this lithologic type in other parts of the section. The shales of the late Jurassic Morrison formation of the Rocky Mountain region are similar in appearance to those of the Schuler formation.

The Dorcheat shales are commonly splotched with red, presenting a mottled appearance. Thin layers of dark red shale occurring at rather wide-spaced intervals throughout the Dorcheat member are similar in appearance to the red

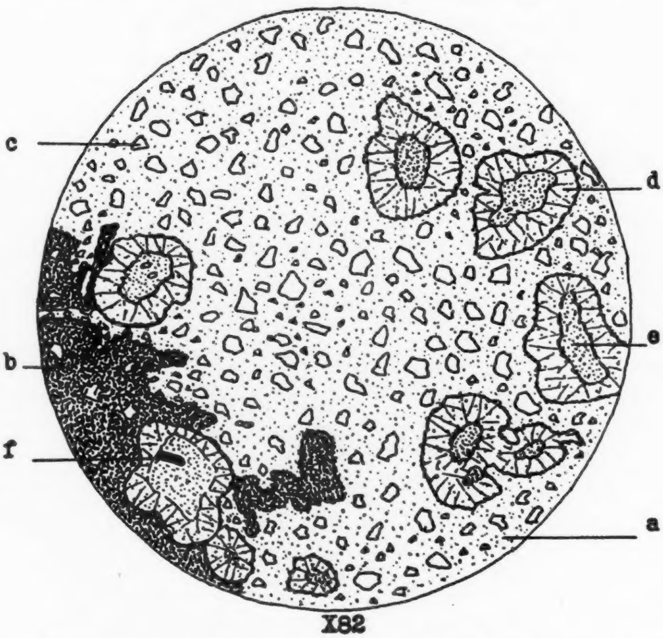


FIG. 11.—Thin section of varicolored, sideritic shale of Dorcheat member of Schuler formation, Dorcheat field, Columbia County, Arkansas. Phillips Petroleum Company's Claudia Phillips No. 1; core 6,821–6,831 feet.
a—Light gray and greenish gray shale.
b—Red silty shale (part of small irregular mottled area).
c—Angular to subangular quartz.
d—Peripheral crystalline zone of siderite pellet.
e—Inner dense zone of siderite pellet.
f—Opaque inclusion in siderite pellet.

Shongaloo shales below. In some wells, the red shales become more abundant toward the base of the member and the underlying upper part of the Shongaloo member has pastel varicolored shales interbedded with the dark red shales, suggesting interfingering between the two members.

Lenticularity is a striking feature of both the sandstones and shales of the nearshore facies of the Dorcheat member. Even in closely spaced field wells, it is not possible to correlate a sand or shale body for any distance laterally. This is

shown excellently in a chart by W. B. Weeks and C. W. Alexander, which illustrates the nature of the sand and shale layers of the upper Cotton Valley beds in the Schuler oil field.[26] It seems probable that none of the individual sedimentary layers of the nearshore facies of the Dorcheat member extends very far laterally, and as a result, it has not been possible to find marker beds within the Dorcheat. The type section of the nearshore facies of the Dorcheat member is here given.

TYPE SECTION OF DORCHEAT MEMBER

Atlantic Refining Company's Pinewoods Lumber Company No. 1, C., NE., NE., Sec. 16, T. 18 S., R. 22 W., Columbia County, Arkansas; Dorcheat Field Discovery Well

Lithology	*Depth (Feet)*	*Thickness (Feet)*
Hosston Formation		
Sandstone; medium-grained, white and reddish, and interbedded red silty shale	6,325–6,402	77
COTTON VALLEY GROUP		
Schuler Formation		
Dorcheat Member (Nearshore Facies)		
Shale; pale gray	6,420	18
Sandstone; white, fine, silty with dark chert grains	6,442	22
Shale; pastel, varicolored, mottled red	6,473	31
Sandstone; greenish-gray, silty, argillaceous with reddish streaks, fine-grained	6,500	27
Shale; pastel, varicolored	6,515	15
Sandstone; white and pinkish, fine-grained, silty	6,525	10
Shale; pastel, varicolored	6,540	15
Sandstone; white, fine, silty	6,568	28
Shale; pastel, varicolored with streaks argillaceous fine-grained sandstone	6,620	52
Sandstone; white, fine-grained with streaks gray silty shale, oil stain	6,645	25
Shale; pastel, varicolored, sideritic with streaks fine white silty sandstone	6,695	50
Sandstone; fine, white, porous	6,705	10
Shale; pastel, varicolored, sideritic, with streaks of gray and white siltstone	6,850	145
Sandstone; white, fine-grained, silty to porous, with argillaceous streaks, oil stain	6,870	20
Shale; pastel, varicolored	6,910	40
Sandstone; white, fine, porous, oil stain	6,920	10
Shale; pastel, varicolored sideritic	6,945	25
Sandstone; white, carbonaceous, porous, oil stain	6,955	10
Shale; pastel, varicolored, with streaks of fine white sand at top	7,035	80
Sandstone; white, silty to porous, asphaltic, interbedded with pale gray shale	7,080	45
Shale; pastel, varicolored, sideritic	7,130	50
Sandstone; white, fine-grained, carbonaceous, with white ash, sideritic; some fragments shale in sandstone (cored), probably as intraformational conglomerate	7,175	45
Shale; pastel, varicolored	7,190	15
Sandstone; white, fine-grained, with dark chert grains	7,218	28
Shale; pastel, varicolored	7,228	10
Sandstone; white, fine-grained	7,242	14
Shale; pastel, varicolored, with streaks of fine white sandstone; a 10-foot bed of solid red shale near top	7,320	78
Sandstone; white, fine-grained, silty	7,350	30
Shale; pastel, varicolored with streaks of fine white in part asphaltic sandstone	7,498	148
Sandstone; white, fine-grained, silty	7,510	12
Shongaloo Member (Nearshore Facies)		
Shale; dark red, silty	7,545	35

[26] W. B. Weeks and C. W. Alexander, "The Schuler Field," *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 26, No. 9 (September, 1942), pp. 1484–85.

Lithologic character of offshore facies.—As in the nearshore facies of the Dorcheat member, the offshore facies comprises an upper shaly unit and a lower, somewhat thicker sandy unit. The bulk of the upper unit of the member consists of dark gray, fissile, oyster-bearing shale. Interbedded with the shales, especially toward the base, are gray coquinoid thin-bedded limestones.

The lower unit of the offshore facies of the Dorcheat member is made up of mostly fine-grained, calcareous, fossiliferous sandstones, with interbedded dark, fissile shales and gray thin-bedded in part sandy, coquinoid limestones. Minor constituents of the sandstones include dark gray novaculitic chert grains, finely divided carbonaceous material, and disseminated pyrite. The upper unit averages less than 400 feet in thickness and the lower exceeds 600 feet in thickness.

In most wells so far drilled in northern Louisiana, the uppermost Cotton Valley beds are those of the nearshore facies, that is, pastel, varicolored, poorly laminated, unfossiliferous shale and fine-grained sandstone with siderite (Figs. 4–7). These beds pass downward into dark gray fossiliferous shales, limestones, and sandstones of the offshore facies. The contact between the Hosston formation and the Dorcheat member in northeastern Louisiana is gradational in most places throughout a "transitional zone" several hundred feet thick. The base of the lowest coarse sandstone of Hosston lithology is considered to be the top of the Cotton Valley group, with the realization that this may not represent the same horizon, chronologically, as the contact chosen in wells updip.

In contrast with the nearshore facies of the Dorcheat, the individual layers of the offshore facies are more persistent laterally. In the North Lisbon field, Claiborne Parish, Louisiana, for example, it is possible to correlate small units within the Dorcheat from well to well by means of electrical logs. However, only a few units can be traced for a very great distance.

A typical section of the offshore facies of the Dorcheat member is here given.

Typical Section of Dorcheat Member

Union Producing Company's McDonald Unit A-1, Sec. 13, T. 21 N., R. 5 W., Claiborne Parish, Louisiana; North Lisbon Field

Lithology	*Depth (Feet)*	*Thickness (Feet)*
Hosston Formation (Basal Beds)		
Sandstone; fine-grained, white, porous	7,475–7,490	15
COTTON VALLEY GROUP		
Schuler Formation		
Dorcheat Member (Offshore Facies)		
Shale; varicolored, sideritic with thin layers of siltstone	7,577	87
Shale; dark gray, fissile with interbedded varicolored shale and siltstone layers	7,670	93
Sandstone; very fine to fine-grained, argillaceous, fossiliferous, carbonaceous	7,700	30
Shale; dark gray, fissile, fossiliferous, with shelly limestone layers in lower half	7,914	214
Sandstone; fine-grained, white, porous to silty, pyritic	7,946	32
Shale; dark gray, fissile, fossiliferous, with layers of fine-grained white sandstone	8,060	114
Sandstone; fine-grained, light gray, slightly calcareous, porous	8,100	40

Lithology	*Depth (Feet)*	*Thickness (Feet)*
Shale; dark gray, fissile with thin layers of green shale	8,143	43
Sandstone; fine-grained, gray, calcareous, carbonaceous	8,153	10
Shale; dark gray, fissile with thin layers green shale, slightly glauconitic, shelly	8,375	222
Shale; dark gray, fissile, fossiliferous with thin layers of fine-grained sandstone	8,550	175
Sandstone; fine-grained, gray, calcareous, fossiliferous and interbedded dark gray shale and shelly limestone	8,685	135
Shongaloo Member (Upper Part)		
Shale; dark gray fissile, with interbedded coquinoid limestone	9,080	395

Wesson tongue.—During the development of the Schuler oil field in Union County, Arkansas, the operators noted the presence of a thin unit of fossiliferous, dark gray, glauconitic shale near the top of the Schuler formation associated with the "Morgan" producing sands, as mentioned in a stratigraphic section of the Schuler field by Weeks and Alexander.[27] Later, sample studies indicated the occurrence of this "tongue" of fossiliferous, dark gray shale in other wells in southernmost Arkansas as far north as the general latitude of central Union County (T. 18 S., Arkansas), which is 10–15 miles north of the zone of principal color change of the Schuler formation. Southward, the tongue expands into the offshore facies, but its probable stratigraphic equivalent can be recognized in wells far to the south as a limestone unit just above the lower sandstones of the Dorcheat member.

The name Wesson is herein applied to this tongue of dark gray, glauconitic, fossiliferous shale near the top of the nearshore facies of the Dorcheat member. The type locality is the vicinity of Wesson in Union County, Arkansas, where two deep wells have been drilled, the Standard Oil Company of Louisiana's Zimmerman No. 1, Sec. 29, T. 18 S., R. 16 W., and the Delta Drilling Company's Pickering No. 1, Sec. 32, T. 18 S., R. 16 W. The type section of the Wesson tongue is here given.

TYPE SECTION—WESSON TONGUE

Standard Oil Company of Louisiana's D. A. Zimmerman No. 1, SE., SE., Sec. 29, T. 18 S., R. 16 W., Union County, Arkansas; Wildcat, Wesson Area

Lithology	*Depth (Feet)*	*Thickness (Feet)*
Hosston Formation (Basal Part)		
Sandstone; white, fine to coarse-grained, conglomeratic, with pebbles of quartz and gray and white chert, partly sideritic, and interbedded red silty shale	5,425–5,503	78
COTTON VALLEY GROUP		
Schuler Formation		
Dorcheat Member (Nearshore Facies) (Upper Part)		
Shale; pastel, varicolored, "siliceous," bearing hard, dark red, nodular hematitic material, sideritic, siltstone layers near base	5,593	90
Sandstone; white, fine-grained, silty	5,610	17

[27] W. B. Weeks and C. W. Alexander, *op. cit.*, pp. 1477–82.

Lithology	*Depth (Feet)*	*Thickness (Feet)*
Shale; pastel, varicolored, and streaks of greenish gray siltstone	5,670	60
Sandstone; white, fine-grained, angular, and interbedded pastel, varicolored shale	5,710	40
Wesson Tongue		
Shale; dark gray, glauconitic, having irregular fracture similar to pastel shale above and below, small gastropod noted (base of Wesson tongue)	5,735	25
Shale; pastel, varicolored, sideritic, and streaks of fine-grained white sandstone and siltstone; some of siderite has multiple-crystalline rosette structure	5,872	137

Stratigraphic relationships.—In northern Louisiana, except in the Monroe uplift, the Dorcheat member is overlain with regional conformity by the Hosston formation. In the central part of the Monroe uplift, which underwent much pre-Gulf erosion (Fig. 6), the Dorcheat is overlain by the late Upper Cretaceous "Gas rock" chalk. There is probably, also, a hiatus between the Hosston and the Dorcheat in this uplift. In southern Arkansas the Hosston may be conformable on the Dorcheat as far north as T. 15 S., but farther north their contact probably is disconformable. In central Calhoun and Bradley, and in northern Ashley counties, Arkansas, the Dorcheat is directly overlain by Gulf sediments as a result of pre-Upper Cretaceous erosion.[28] In northeastern Texas, scant information indicates that around the margins of the East Texas basin, the Hosston rests unconformably on the Dorcheat. In the Stoddard *et al.* Smith No. 1, southeastern Ellis County, the Hosston rests on the Shongaloo member as a probable result of erosion of all the Dorcheat member (Fig. 8).

In Mississippi and Alabama, the few wells drilled to the Cotton Valley show that the beds overlying the Dorcheat member consist of thick, coarse, conglomeratic sandstones probably Cretaceous in age.

In southern Arkansas and northern Louisiana, the Dorcheat member rests conformably on the Shongaloo member, and in some areas shows color-interfingering with it. In Nevada County, Arkansas, the Dorcheat member overlaps the Shongaloo and rests directly on the Smackover limestone (Fig. 4). In northeastern Texas, the Dorcheat is conformable on the Shongaloo in most of the wells. However, in northwestern Bowie County, the Dorcheat overlaps the Shongaloo and rests on indurated Paleozoic sandstone (Fig. 8).

Stratigraphic Summary

The best control for a study of the deep Upper Jurassic rocks of the northern Gulf Coastal Plain is in southern Arkansas and northern Louisiana, because of the large number of wells that have been drilled there. Information obtained from these wells serves as a standard for comparison with outlying areas of northeastern Texas, Mississippi, and eastward.

Reclassification herein of the entirely subsurface Cotton Valley beds as a group, rather than a formation, is believed justified as a result of the recognition

[28] W. B. Weeks, *op. cit.*, Fig. 1, p. 957.

within it of two subdivisions of formational rank. The lower of the two formations, the Bossier, consists in the type section, east-central Bossier Parish, Louisiana, of fossiliferous dark gray and black shale and argillaceous limestone 1,635 feet thick. On the north and east, the lower Bossier becomes sandy, and in the Monroe uplift, it passes into redbeds. Present knowledge indicates that it underlies all of northern Louisiana, may underlie the East Texas basin, but is limited, approximately, to the southernmost two tiers of townships in Arkansas. It ap-

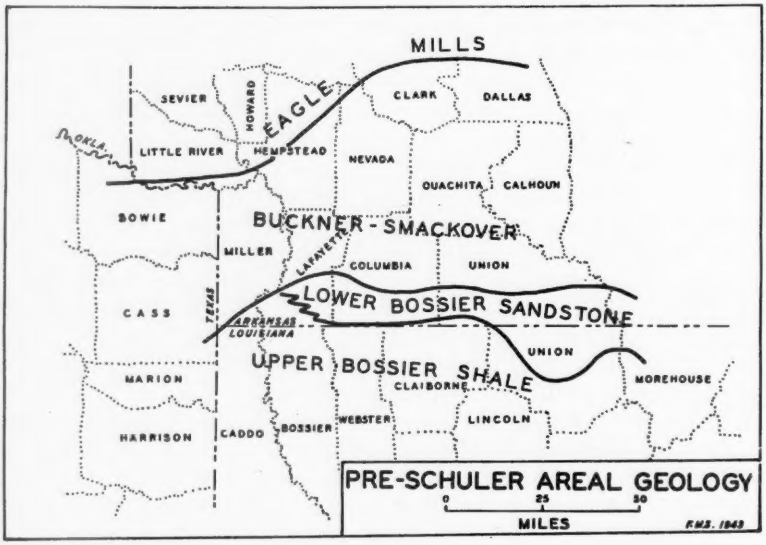


FIG. 12.—Pre-Schuler (pre-Portlandian?) areal geology.

parently is conformable on the underlying Buckner red shale and anhydrite, but locally rests disconformably on the Smackover limestone in southern Arkansas, and in such places may also be disconformable on the Buckner. The Bossier is overlain in part with probable angular unconformity by the Schuler formation which overlaps it north of T. 18 S., Arkansas, but south of T. 21 N., Louisiana, the two formations may be conformable.

The ammonites *Idoceras durangense* Burkhardt and *Glochiceras fialar* (Oppel) and the pelecypod *Aulacomyella* have been identified by Imlay[29] from cores near the middle of the Bossier formation at the type locality. These fossils provide a correlation with the middle Kimmeridgian of Mexico according to Imlay.[30] The

[29] R. W. Imlay, *op. cit.* (1943), pp. 1470–72.

[30] *Ibid.*

Bossier may therefore represent the middle and upper Kimmeridgian as the underlying "marine Buckner" formation contains the lower Kimmeridgian ammonite *Ataxioceras*.[31]

The upper formation of the Cotton Valley group is named the Schuler formation from the Schuler oil field in central Union County, Arkansas, where it is 2,090 feet thick and comprises a lower subdivision of red shales and sandstones, and an upper subdivision of varicolored pastel shales and sandstones. Southward, near the Arkansas-Louisiana state line and paralleling it, these nearshore rocks pass laterally into offshore dark gray shales, limestones, sandstones, and basal conglomerates. Because of their widespread extent, the two subdivisions of the Schuler formation are named the Shongaloo member and the Dorcheat member in ascending order.

The Shongaloo member, named from the town and oil field of Shongaloo, Webster Parish, Louisiana, consists of an upper unit of shale, sandstone, and limestone, and a lower unit of conglomerate, sandstone, shale, and limestone, occurring in two facies recognized by color. The nearshore facies is made up of red and green shale of darker color than that of the overlying Dorcheat member, red and white sandstone, and conglomerate. This facies is restricted mainly to southern Arkansas and the Monroe uplift in northeastern Louisiana. The offshore facies comprises dark gray fossiliferous shale, sandstone, limestone, and basal conglomerate, and is restricted mainly to north-central and northwestern Louisiana and the East Texas basin. The Shongaloo member attains a thickness in excess of 1,000 feet in T. 18 S., Arkansas, and thins both shoreward and basinward from this latitude. North of T. 17 S., Arkansas, this member overlaps the underlying Bossier formation and rests on the Buckner or the Smackover formation. As far south as T. 21 N., Louisiana, the Shongaloo rests with probable angular unconformity on the Bossier, but on the south their contact may be conformable. The Shongaloo member is overlain conformably by the Dorcheat member except in updip areas of southern Arkansas and northeastern Texas where the Dorcheat overlaps it locally.

The Dorcheat member, named from the Dorcheat oil field, Columbia County, Arkansas, consists of an upper shale and sandstone unit and a lower sandstone unit. There are two facies of the member, which are recognized by color. The nearshore facies comprises pastel varicolored shales, and white sandstones in which small pellets of brown siderite are abundant. The offshore facies comprises dark gray fossiliferous shale, sandstone, and shelly limestone. The Dorcheat member attains a thickness in excess of 1,200 feet near the Arkansas-Louisiana state line and thins both shoreward and basinward. The Dorcheat is overlain unconformably by the lower Comanche Hosston formation north of T. 15 S., Arkansas, and around the northern and western margins of the East Texas basin, but southward their contact is probably conformable. The Dorcheat is conformable on the Shongaloo member, but overlaps it locally in updip areas.

[31] *Ibid.*, p. 1456

Paleontological evidence of the age of the Schuler formation is meager, but pelecypods obtained from cores in the Schuler are of Jurassic age according to Imlay.[32] The Schuler may be Portlandian and Tithonian in age, as it rests unconformably on the middle and upper (?) Kimmeridgian Bossier formation.[33]

TABLE II

TIME RELATIONS OF UPPER JURASSIC FORMATIONS IN SOUTHERN ARKANSAS AND NORTHERN LOUISIANA
(Prepared in collaboration with R. W. Imlay)

European Stages		Southern Arkansas	Northern Louisiana
	Tithonian	Hiatus SCHULER FORMATION	
	Portlandiah	nearshore "red beds" basal conglomerate	offshore fossiliferous beds
Kimmeridgian	Bononian		BOSSIER FORMATION
Kimmeridgian	Havrian	Hiatus	Idoceras cf. I. durangense Glochiceras cf. G. fialar Aulacomyella sp.
Kimmeridgian	Sequanian	BUCKNER FORMATION anhydrite and red beds	Ataxioceras
Oxfordian	Argovian	SMACKOVER LIMESTONE FORMATION	Dichotomosphinctes Discosphinctes
Oxfordian	Divesian	EAGLE MILLS FORMATION red beds Norphlet tongue Louann tongue	massive salt
	Callovian	Hiatus	

Table II illustrates the time relations of the Upper Jurassic rocks of southern Arkansas and northern Louisiana.

A discussion of the sedimentary and structural history of the Cotton Valley group must await a separate study of the adjacent rocks. However, it is appropriate to make a few observations relating to this subject. 1. The Sabine uplift was a positive area as early as middle Kimmeridgian time, because both the Bossier and Schuler formations are relatively thinner there than in surrounding areas. 2. The Monroe platform was not an important positive feature during late Jurassic time, as great thicknesses of nearshore sediments accumulated there. 3. The offshore parts of the Bossier formation probably were deposited in relatively deep water resulting in the formation of almost black ammonite-bearing shale. 4. The offshore parts of the Schuler formation were deposied in relatively

[32] R. W. Imlay, personal communication.

[33] R. W. Imlay, personal communication.

TABLE III

DISTRIBUTION OF PRODUCING SANDS OF COTTON VALLEY GROUP

Stratigraphic Divisions of Cotton Valley Group				Fields Producing from Cotton Valley Sands											
				Schuler	Dorcheat-Macedonia	New London	Mount Holly	Nick Springs	McKamie	Atlanta	Cotton Valley	Shongaloo	North Lisbon	Beekman	Homer
COTTON VALLEY GROUP	Schuler Formation	Dorcheat member	Upper shale and sandstone unit	some "Morgan" sands							"A" sand				
			Lower sandstone unit	most "Morgan" sands	some producing sands		"Lewis" sand	producing sand	"Cornelius" sand		"B", "C", "D", "Bod-caw", and "Davis" sands		"Duke", "Simmons", "Vaughn" sands	"Beekman" sand	
		Shongaloo member	Upper shale and sandstone unit	producing sands	"B-1" sand					"Young" sand		"Roseberry" sand			
			Lower conglomer-atic sandstone unit	"Leona" sand	some producing sands	producing sands						"Sexton" sand	"McDonald" sand		producing sand
	Bossier Formation			"Jones" sand											
Smackover Limestone Formation (upper oölitic unit)				production	product-ion	show oil / water	production	water	production	production	not tested	not tested	production	show oil / dry	no porosity

shallow water, abundantly inhabited by oysters. 5. The nearshore Shongaloo sediments probably were derived from a backland having steep relief, resulting in the formation of conglomerates, and were deposited in an environment which prevented widespread reduction of the red coloring in the clays. 6. The nearshore Dorcheat sediments probably were derived from an area of less steep relief and underwent more complete reduction of the originally red color than the Shongaloo sediments. 7. These observations, supported by evidence of local transgression of the Shongaloo by the Dorcheat, suggest that an almost complete cycle of erosion is represented by Schuler time. 8. In East Texas, the belt of nearshore rocks of the Schuler formation is much narrower and this formation is relatively thinner than in southern Arkansas. 9. In western Alabama, the standard subdivisions of the Cotton Valley group are not well defined due to differences in source and mode of deposition, but both formations probably are represented there.

Sandstones in the Cotton Valley group have produced large amounts of petroleum and new deposits are being found each year. The Cotton Valley producing sands are listed by fields in Table III.

BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGI TS
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HOW TO MAKE VELOCITY CORRECTIONS[1]

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ABSTRACT

The fundamental assumptions in regard to velocity distribution and the effect of these assumptions in the computation of reflection-seismograph data are discussed. Simple methods for adjusting reflection-seismograph information for lateral changes in vertical velocity are explained and illustrated.

INTRODUCTION

Since the first dowser[3] allegedly located water by the necromantic twitchings of a willow wand or other enchanted instrument, there has been a regrettable tendency, even among some of the more scientific varieties of "doodlebuggers," to surround some of their functionings with considerable mystery. In the field of the reflection-seismograph velocity changes have great magic. They are so miraculous that they work both ways; an unexpectedly high well can be explained as easily as a disastrously low one, provided, of course, that the velocity changes can be demonstrated to be in the right direction.

Regardless of the possibility that velocity changes can be used as a convenient excuse to explain seismograph failures, there is good evidence for their existence, and correction for them is an important factor in the interpretation of seismograph information. In many organizations geologists are charged with the responsibility of making geologic structural contours on the basis of seismograph data. Unless they understand thoroughly the implications involved in the assumptions used in the application of the computing methods and the rôles which velocity and velocity changes play in the computation of seismic data, they are not in a position to arrive at the best answer. Many geologists seem to feel that they are not sufficiently well qualified in the fields of physics and mathematics to be able to comprehend the mysteries of reflection shooting. This feeling of inferiority is unwarranted. Contrary to popular belief, a knowledge of trigonometry, Huygen's principle, and Snell's law is the only prerequisite necessary to develop a good working knowledge of reflection-seismograph computing techniques. The calculus is useful in demonstrating certain mathematical proofs, but is not used in routine computation. Anyone who knows enough mathematics to be able to measure and compute the thickness of an outcrop section will be able to compute reflection-seismograph observations. The purpose of this article is to show some simple methods for making velocity corrections that the geologist will find easy to use and to give him some basis for judging, at least to a limited extent, the probable value, for correlation purposes, of the reflection data at hand. To do this it will be necessary to review some of the elementary considerations which deter-

[1] Manuscript received, October 25, 1943.

[2] Honolulu Oil Corporation.

[3] Probably Moses.

mined the choice of the computing method that was used in plotting the reflection information. The writer appreciates the geologist's dislike for long mathematical treatments. This feeling arises, probably, not only because mathematics is usually a tool long rusty from disuse, but, also, from a constitutional dislike for the subject in the first place. However, a certain amount of mathematical formulation is necessary.

FUNDAMENTAL ASSUMPTIONS

In reflection shooting the instruments measure only the time it takes a compressional wave to propagate from a dynamite explosion down to a reflector and then to return to a series of microphones at the earth's surface. These measurements have no relation to geology except in so far as the assumption is satisfied that the reflector coincides with a bedding plane or with a lithologic or structural change. The determination of the special relationships of this reflector and its geologic structural significance is dependent entirely on our knowledge of the velocity distribution and on the validity of the foregoing assumption. Since we never have enough data regarding the nature of the velocity distribution, certain assumptions must be made. We know that, at least to a certain depth, the average velocity generally increases with depth, although some intervals may show velocity inversions. Therefore, an increasing velocity function is usually one of the first assumptions. Another fundamental assumption from a practical viewpoint is that the velocity layers or, more properly, the levels of equal velocities, are parallel. It is also necessary to make some estimate of the relation of the structural attitude of the reflectors to these iso-velocity layers. Several possible systems are in use. These are discussed in the following paragraphs.

CASE I. The velocity is a constant.

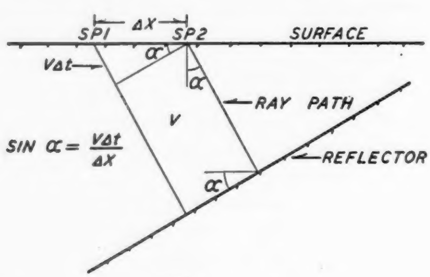


FIG. 1

This is by far the simplest case, but it is duplicated in nature over only a very limited vertical range. The trajectories are straight lines.

CASE II. The speed layers are horizontal and parallel, and the reflectors are horizontal.

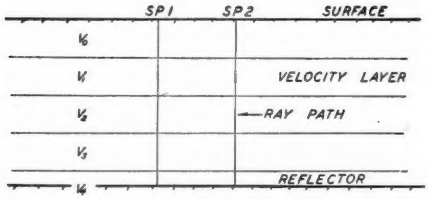


FIG. 2

This is a valid approximation in the case where the values of dip are small, not more than 3°–5°. Even with these magnitudes the effect is to broaden the anticlinal folds and minimize the synclines. The ray paths are straight lines, and the reflections at normal incidence plot directly beneath the shot points. If this practice is carried out for high-angle dips, it may give a disastrous result: the interchanging of the location of the anticlines and synclines.

CASE III. The velocity layers are parallel and horizontal.

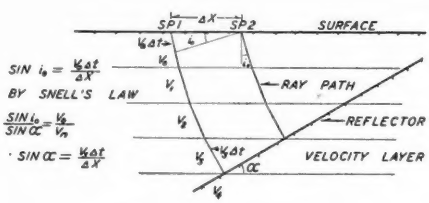


FIG. 3

Except for horizontal beds, the trajectories are curves. When one assumes a linear increase in instantaneous velocity with depth the ray paths are circular. This is one of the more common assumptions used by up-to-date geophysicists. The dip is calculated by the formula shown in the figure. If the assumption of horizontal speed layers were accurate, there could be no lateral variations in velocity. Obviously this assumption is only an approximation.

CASE IV. The speed layers are all parallel with the reflector.

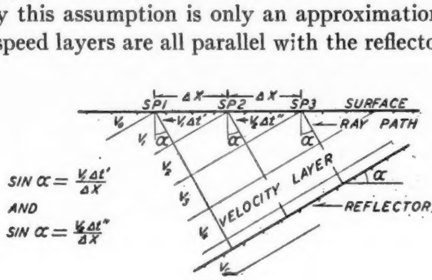


FIG. 4

No matter what is the rate of increase of velocity with depth, this assumption always yields straight-line trajectories. The angle of dip is computed by the formulas shown in the figure, using the surface velocity. Probably, this assumption is satisfied only in exceptional cases. It also has the practical drawback of requiring continuous lateral changes in the values of the vertical velocity function except in the direction of strike of the velocity layers. This makes the computational procedure very difficult. The assumption is not in general use.

CASE V. The speed layers are parallel and are inclined at some angle, k, to the reflector.

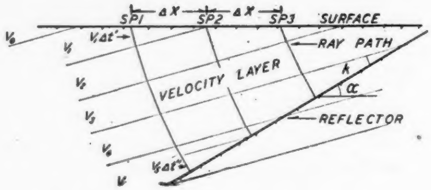


FIG. 5

It can be seen from the figure that the difference in the length of the ray paths from SP_1 and SP_2 is the distance $V_1\Delta t'$ plus $V_5\Delta t''$ which is very difficult to determine. For relatively flat dips this distance approximates the difference in depth of the reflector at the reflection points. The trajectories are curves. As in Case IV this assumption also requires continuous lateral changes in the values of the velocity function which makes it impracticable.

An excellent discussion of the problem of the attitude of the speed layers with reference to the inclination of the geologic strata in the Tertiary basins of California is given in a paper by W. Hafner.[4] He points out that the speed layers sometimes dip in the opposite direction from the reflecting beds; they sometimes dip more steeply; and there does not seem to be any tendency to reach an average relationship to the reflectors. He found, also, that the speed layers were not parallel in detail, but that their departure from parallelism is in the nature of a random irregularity which would not fit any preconceived or determinable systematic arrangement. However, he did find that certain regional characteristics, such as a general dip of the velocity layers in the same direction as the regional dip, obtained. While these observations were confined to the Tertiary basins of California, it is likely that similar conditions exist in other Tertiary basins of the world and probably in more ancient rocks as well.

In spite of these observed data, and in spite of the fact that to justify some of the assumptions that are used, we would know so much of the geology that we would not have to do any reflection shooting, there are still persistent beliefs

[4] W. Hafner, "The Seismic Velocity Distribution in the Tertiary Basins of California," *Bull. Seis. Soc. America*, Vol. 30, No. 4 (1940), pp. 309–26.

that the attitude of the speed layers must be inclined in some regular fashion and must be incorporated in the computing method. These ideas vary from that illustrated in Case IV to the assumption that the speed layers are parallel at the surface and dip at a rate which varies as a function of the depth. In this latter case we no longer deal with parallel speed layers and a computational procedure can be developed only after a number of approximations are resorted to. These procedures usually end up by being inconsistent. By taking a certain attitude of the speed layers with reference to the reflectors, the use of the average velocity in computing the dip of the reflectors can usually be justified. This is a common practice. Consistent results would be forthcoming if the velocity-depth function were changed continuously in all directions at an angle to the strike of the velocity layers, as pointed out in Case IV. For practical purposes, in computing it is virtually necessary to hold the velocity distribution with depth constant over an area, and that is a customary practice. This is the assumption illustrated in Case III. Thus, we have inconsistent and contradictory reasoning. What is the practical result? The differential depths of the reflection points will be determined approximately by the relationship, $\Delta Z = \Delta x \sin \propto$, in which

$$\sin \propto = \frac{V_3 \Delta t}{\Delta x},$$

or, ΔZ is approximately $V_3 \Delta t$ (Fig. 3). The dip, on the other hand, will be derived from the formula,

$$\sin \propto' = \frac{V_a \Delta t}{\Delta x}$$

in which V_a is the average velocity and is considerably less than the instantaneous velocity, in this case, V_3. Consequently, the dip of a continuous reflector, as determined by the depth points, will be much greater than that determined by the dip shots. This results in shingling of the dips as shown in Figure 6.

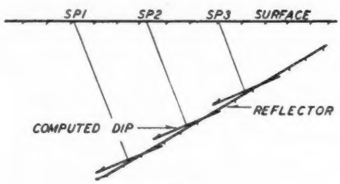


FIG. 6

Thus, in projecting phantom horizons down dip along dips calculated in this manner, one continually projects into reflections from younger strata. In projecting updip, data from successively older beds are used.

There are many ways in which the assumed attitude of the velocity layers may be varied and any of those that give results that are inconsistent within themselves are bad. Before working on a seismograph section, the geologist must satisfy himself that the data are computed in a manner that will not be self contradictory. If this condition is not satisfied, the only thing for the geologist to do is to recompute the observed values with an assumption that will give consistent results. Otherwise, he will never be able to make any of his correlations fit.

What, then, will determine the choice of a suitable computing method? The following conditions must be satisfied.

1. It must allow for an increase of velocity with depth, at least until certain limiting values are reached.

2. It must be practicable. In other words, the assumptions must result in solvable equations and a method of plotting that will be economical. This condition precludes the assumption of anything but parallel, horizontal, speed layers.

3. It must be consistent within itself.

At best a computing method is only an approximation. The aim should be to most nearly duplicate in a practicable manner the observed conditions of time-depth relationships in the particular area under consideration. In the sedimentary basins with which the writer has had experience, a linear increase of velocity with depth, or, a linear increase to an arbitrary depth and a constant velocity beyond that point with horizontal speed layers, has been found to be very satisfactory. These assumptions not only fit the observed vertical velocity distribution closely, but they satisfy the demand for self consistency of the computing method, and that is the most important factor. Furthermore, they adapt themselves well to treatment in correcting for lateral variations in the vertical velocity distribution.

CORRECTION TECHNIQUES

In the following discussion the formulas are derived on the basis of a linear increase of vertical velocity, or, in equation form, $V_z = V_0 + kZ$, in which V_z is instantaneous velocity at depth Z, V_0 is the initial velocity, and k is the rate of increase with depth. The reader may find that this treatment is not pertinent to his problem, but, whatever the velocity distribution, the basic philosophy is the same so that it will probably not prove too great a chore to adapt these principles to the particular need. It is assumed that the observed record time has been corrected for weathering and adjusted to some datum.

METHODS FOR MEASURING VELOCITIES

It will be well to review briefly the present generally employed methods for measuring velocities in order that the reader may be enabled to judge better the relative value of the velocity information that he may have available before he tries to correct anything with it.

1. *Reflection-shooting methods.*—There are several variations of this type of measurement which arise directly from the geometrical pattern of the shot point, instrument set-up and the reflectors.

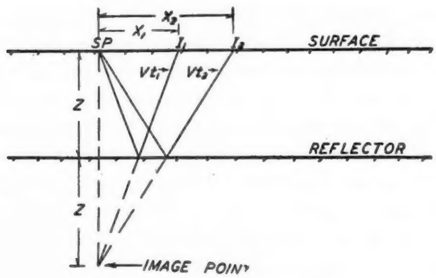


FIG. 7

In the diagram (Fig. 7) we can see that the length of path from the shot point to the reflector and then to the instruments, I_1 and I_2 is Vt_1 and Vt_2, respectively. In the two right angle triangles, I_2, shot point, image point and I_1, shot point, image point, we can set up the two following equations:

$$Vt_2^2 = X_2^2 + 4Z^2 \tag{1}$$

$$Vt_1^2 = X_1^2 + 4Z^2. \tag{2}$$

Subtracting (2) from (1) we have

$$V^2(t_2^2 - t_1^2) = X_2^2 - X_1^2 \tag{3}$$

This means that if we plot the squares of the arrival times against the squares of the distances to the respective, successive, instruments, a straight line will result. The slope of this line will be equal to the square of the reciprocal average velocity between the surface and the reflector (Fig. 8).

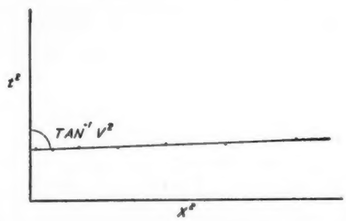


FIG. 8

Reading errors, difficulties in identifying the first impetuses of the reflected waves, correction errors, change of frequency of the reflected waves with distance, deviation of the reflector from a plane surface and other factors operate to limit the accuracy of velocity measurements by this or similar methods. Although some workers claim three-place accuracy by refinements in shooting and by exhaustive mathematical treatment of the observations, it is the writer's experience that these claims have so far proved unwarranted. Under optimum conditions, probably only two-place accuracy can be obtained. The writer knows

of cases in which, even though the reflections were unusually good, the velocities determined by a variation of this method were wrong. These failures were attributed to the fact that the fundamental assumption of a plane reflecting surface was not satisfied. At present it seems safer to regard a velocity measurement of this type as possibly giving a satisfactory first approximation, the accuracy of which, under the best conditions, does not exceed two places. Such values are acceptable for reconnaissance work and for determining regional velocity trends, but they are not sufficiently fine for making detailed corrections. In addition, the accuracy decreases rapidly as the depth to the reflectors increases.

2. *Direct methods.*—The direct measurement made by lowering a geophone into a well and recording the time for a compressional wave to travel from a near-by surface point to the geophone has proved to be the best way of determining velocities. It has become very popular since coöperative efforts have lowered the cost of participating in such surveys. To insure reliable values, care must be taken that the depths are measured accurately, that the timing system is accurate, that the shot-hole geophone is of proper design, that the computer will be able to differentiate between the kick of waves that travel down the casing or geophone cable and the compressional wave traveling through the earth, that the shot holes are located in a manner which will allow corrections to be made for a crooked hole, sharp, local variations of velocity, and local irregularities in the weathering layer, and that corrections of the arrival times to a datum are made in a manner consistent with good computing practice. If the preceding conditions are fulfilled, well surveys usually give data which are sufficiently accurate to warrant the use of the information in making detailed corrections for lateral variations in vertical velocity.

USE OF TIME-DEPTH CURVES

Well velocity data usually are submitted in the form of a time-depth curve, an average velocity curve, and an interval velocity curve. Of these, the most useful is the time-depth curve.

We continue to think in terms of velocity when we are really interested only in the relationship between depth and time. Velocity is merely their quotient. It is not something that is measured directly in our well surveys. The comparison of these observed data with the assumed, or approximated, time-depth relationship will give directly the full measure of correction to be applied to depths based on the latter.

For the purpose of illustration, let us assume that we have an area that has been suitably shot to give a reliable seismograph contour map constructed on the assumption of a vertical velocity distribution held constant throughout the area. Suppose that it approximates closely the measured time-depth observations in one well, *A*, and that we have time-depth data in three other wells. These curves are shown in Figure 9, plotted from the same datum. Referring to the figure we see that the position of the *N*-sand in well *A* occurs at a time of 0.816 second and

this time on our assumed velocity distribution corresponds with a depth which is about 50 feet shallower than the actual depth in well *A*. This means that the reflection from the top of the *N*-sand will have been plotted 50 feet too high and

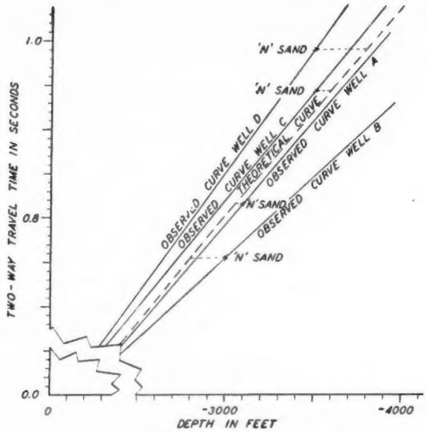


FIG. 9

will have to be lowered by that amount. Since we are dealing with subsea depths, we will have to add −50 feet to the depth of the reflection contours at well *A*. In a similar fashion we arrive at the conclusion that the necessary corrections at wells *B*, *C*, and *D* are −200 feet, +100 feet, and +300 feet, respectively. Corrections at other interesting geologic horizons can be derived in the same way. These

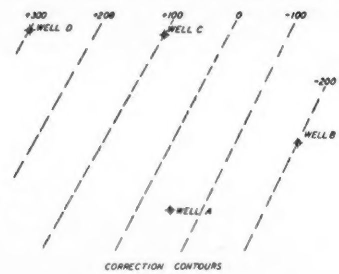
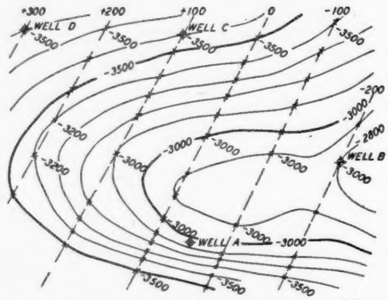


FIG. 10

figures give a direct measure of the corrections which must be added to the relative elevations determined by reflection shooting to give the same relative elevations as the geologic markers. These corrections can be contoured and applied in transforming the seismograph contours into geological structure contours.

In Figure 10 these values have been contoured by assuming linear distribution of values between observation points. Some workers object to the use of the as-

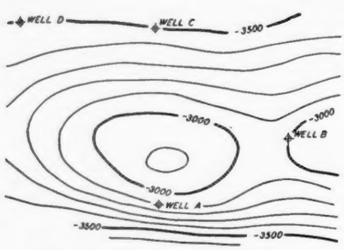
sumption of linear distribution of the correction and make an adjustment on the basis of some more complicated form usually based on an estimate of the effect of uplift or changing section on the velocity distribution. These complicated assumptions usually require a far greater knowledge of geology and the relationship of geologic structure and stratigraphy to the velocity changes than is generally available. For this reason a linear adjustment is to be preferred.



CONTOURS ON A REFLECTING HORIZON NEAR THE TOP OF THE 'N' SAND WITH CORRECTION CONTOURS

FIG. 11

In Figure 11 correction contours are shown superimposed on contours of a phantom horizon drawn on reflection data from near the top of the N-sand computed by use of the theoretical curve of Figure 9 and not corrected for lateral variations in velocity. At the intersections of these two sets of contours some of the corrected values are shown.



STRUCTURAL CONTOURS ON THE 'N' SAND

FIG. 12

In Figure 12 the adjusted contours are drawn. Here the relative elevations fit the well data and we now have a *structural* picture from our seismograph data. It will be well to mention again that seismograph data are not necessarily synonymous with structural information. The degree to which reflection data simulate geologic structure depends largely on how closely the velocity function duplicates actual time-depth relationships and on how the time-depth values vary

laterally. It is well for the geologist to differentiate, at least mentally, between seismograph contours and structural contours.

The foregoing corrections could have been applied directly to the seismograph profiles and the corrected structure contoured from the profiles. The greatest objection to this procedure is that as additional time-depth information becomes available, one must continually return to the profiles to make adjustments. If a map contoured strictly on seismograph data is available it can easily be corrected and kept up-to-date by the method outlined in preceding paragraphs.

In applying this type of correction, it is important that all of the time-depth values are referred to the same datum. If the well surveys are not all made to the same datum, the origin of the curve must be shifted to a common point. The following rule will help to avoid confusion and mistakes regarding the direction in which the origin must be shifted. If the datum chosen for comparison is deeper than the survey datum, the origin will be moved up the curve. If the comparison datum is higher than the survey datum, the origin will be moved down the curve.

In the foregoing discussion the adjustments have been made strictly in a vertical direction, without consideration of the shift in offset, or lateral migration, of the reflection points produced by the change in velocity distribution. As long as the dips do not exceed 15° and as long as the relative depth adjustments are rather small, the error introduced by making only vertical adjustments will be of the same order of magnitude as the inherent inaccuracy of reflection shooting. The error can therefore be ignored, provided that the original dips were migrated in the proper manner. For dips greater than 15° other techniques, which are beyond the scope of this paper, must be used. Even with these steeper dips, however, the remarks concerning the fundamental implications of the assumed velocity distribution are still pertinent and care must be taken to insure that the computing method that is used will give results that are consistent within themselves.

CONSTRUCTION OF TIME-DEPTH CURVES

The actual construction of theoretical time-depth curves is fast and simple, and it requires but little mathematical knowledge. In the assumption of a linear increase of velocity with depth, the time-depth relationship for a vertical path is given by the equation

$$Z = \frac{V_0}{k}\left(e\frac{kT}{2} - 1\right)$$

in which Z is depth, V_0 is initial velocity, k is rate of increase of instantaneous velocity with depth, e is the base of natural logarithms, and T is the time from datum to reflector and back to datum. Values of the exponential, $e\frac{kT}{2}$, can be read from exponential tables for assumed values of T and the rest of the operation is a

simple matter of subtraction and then multiplication by the ratio $\frac{V_0}{k}$. If for any reason it is desirable to change the datum, the value of V_0 will change by the amount of the difference in elevation of the data multiplied by the rate of increase, k. If the new datum is lower than the old one, V_0 will be larger; if higher, V_0 will be smaller. The computation of time-depth relationships from other assumed velocity distributions is equally simple, provided, of course, that the assumed velocity distribution is simple.

OTHER TYPES OF VELOCITY ADJUSTMENTS

Reflection-shooting programs are usually started in rather small areas, and a velocity distribution suitable to each area is generally used. As the programs are

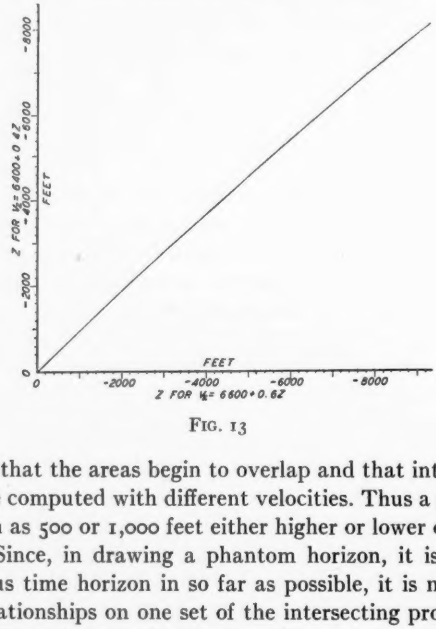


FIG. 13

expanded, we find that the areas begin to overlap and that intersecting and connecting profiles are computed with different velocities. Thus a given horizon may be plotted as much as 500 or 1,000 feet either higher or lower on one profile than it is on another. Since, in drawing a phantom horizon, it is desirable to stay within a continuous time horizon in so far as possible, it is necessary to adjust the time-depth relationships on one set of the intersecting profiles.

In the case of linear increase in velocity where the rate of increase has been held constant laterally and only the initial velocity has been varied, the problem reduces itself to a simple relationship as the following equations show:

$$\frac{Z}{Z'} = \frac{\frac{V_0}{k}\left(e\,\frac{kT}{2} - 1\right)}{\frac{V_0'}{k}\left(e\,\frac{kT}{2} - 1\right)}. \qquad (4)$$

For equal times this relation becomes

$$Z = \frac{Z'V_0}{V_0'} \tag{5}$$

in which Z and Z' are depths corresponding to the initial velocities V_0 and V_0', respectively. This ratio can be solved with a slide rule. Care must be taken that the initial velocities are referred to the same datum.

In cases in which the linear increases have been varied over a wider range or in which time-depth points of a linear increase in velocity must be compared with those based on some other velocity distribution, a different technique is necessary. Depth points on each velocity assumption are plotted against each other for equal times from the same datum. By the use of the resulting curve (Fig. 13) the transformation from one time-depth relation to another can be made directly in terms of depth. For example, in Figure 13 a point that was plotted at $-6,000$ feet for the velocity distribution, $V_z = 6,600 + 0.6Z$ (datum: sea-level) would be plotted at $-5,400$ feet for the velocity distribution $V_z = 6,400 + 0.4Z$ (datum: sea-level).

CONCLUSION

From a consideration of the foregoing discussion, the following points are manifest.

1. Reflection data are not necessarily synonymous with geological information. They approximate geological information to the degree that the velocity assumption on which they are computed approximates the true velocity distribution, and, in so far as the basic assumption is satisfied that the reflectors correspond with bedding, a lithologic or structural change.

2. The assumptions used as a basis for computing reflection-seismograph data should be simple and consistent within themselves.

3. It is best to correct for lateral variations in vertical velocity in some later stage of interpretation and not attempt to incorporate such corrections into the computing procedure.

4. Of the present methods of measuring velocities, only the data derived from well velocity surveys are considered to be sufficiently accurate to warrant their use for making detailed corrections of seismograph data.

5. The procedure for applying corrections can be reduced to a simple matter of addition and subtraction without any sacrifice of accuracy.

This discussion is not offered as a panacea for all of the ills and discrepancies arising from reflection work. Interpretation of reflection-seismograph data must start from the records. A dissertation on the practices and techniques employed in picking records is not included. Although these techniques seem sometimes to incorporate the finer points of rhabdomancy, their magic is beyond the scope of this paper. Perhaps that is a mistake because record interpretation is fundamental and should be discussed first. However, it involves the personal equation

to such a high degree that it is doubtful if we could ever get any two persons to agree on exactly what constitutes a pickable reflection. On the other hand, the choice of computing methods is a matter of logic and is therefore amenable to solution by argumentation and debate. It is hoped that this discussion will help some geologist to solve some of his interpretation problems. With equal fervor it is hoped that this discussion will not give him an unjustified overconfidence in his ability to interpret reflection data by making it seem too easy. To reiterate, interpretation must start with the records and computing methods are a secondary consideration.

ACKNOWLEDGMENTS

Over a period of years the ideas expressed herein have been discussed with many associates and have often been mentally ruminated. As a result, it is impossible for the writer to acknowledge his debt to those individuals who have stimulated his interest in a greater study of these subjects. To all of these associates he is deeply grateful. Robert LaRue has been kind enough to review the manuscript and has suggested some pertinent changes.

P. F. Brown has read the manuscript and in his capacity as an official of the Honolulu Oil Corporation has given permission for its publication.

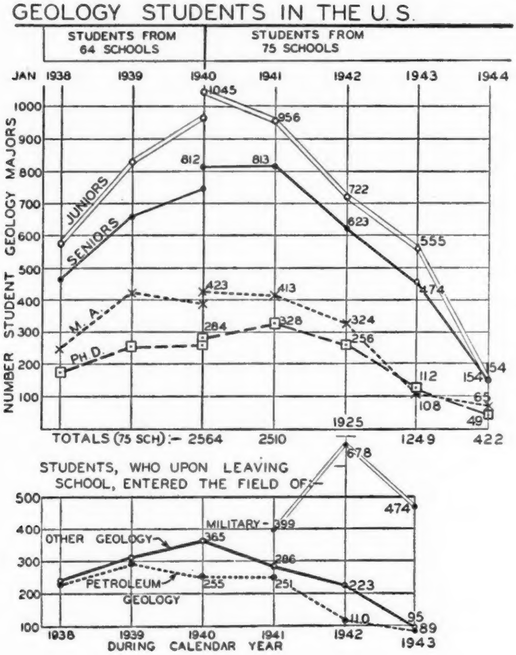
BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
VOL. 28, NO. 5 (MAY, 1944), PP. 629-632, 1 FIG.

RESEARCH NOTES

SURVEY OF COLLEGE STUDENTS MAJORING IN GEOLOGY[1]

A. I. LEVORSEN[2]
Tulsa, Oklahoma

The chart shows the trend in the number of college students majoring in geology and the placement of those leaving school. The latest figures are as of January, 1944. Most of



the 422 students majoring in geology, shown in January, 1944, are women, foreign nationals, or persons not eligible for the military service. Students in the military classifications (such as V-12, V-5, *et cetera*) are not included in the totals.

[1] Manuscript received, March 29, 1944.

[2] Member, research committee. 221 Woodward Boulevard.

APPLICATION OF RESERVE ESTIMATES OF HYDROCARBON FLUIDS (CRUDE OIL, GAS, AND CONDENSATE)[1]

D. V. CARTER[2]
Dallas, Texas

The significance of reserve surveys is frequently misunderstood by persons not familiar with the premise on which a particular reserve survey is based. For example, some surveys include proved and developed acreage; other surveys may include estimates of reserves for proved and developed acreage plus an estimate of reserves for the proved but undeveloped acreage. When making comparisons between surveys, these several possible premises should be kept in mind by those using such information.

Estimates of reserves are the end point of geological and engineering data and should not be accepted blindly without a review of the methods by which the estimates were obtained. To realize fully the benefits of reserve estimates, the efficient rate of estimated future production should be given primary consideration since it is intimately related to the economics of oil and gas property operation, and in a broad sense it is a part of the reserve picture. Regardless of whether any conservation laws are in effect for any field, or whether the field is being produced without any restrictions, estimates of available rates of production for the future are necessary in making a complete survey of reserve estimates and their availability. In other words, estimation of reserves, in a broad sense, should include estimated rates of future production or availability by time periods such as years. Reserve estimates, instead of being considered as a side issue, should assume paramount importance and require all of the geological and engineering data possible for their creation.

One of the frequent errors made by geologists and engineers is the confinement of detailed reserve estimates to properties owned by the companies making the survey, thus disregarding other properties in the field. Many times a false picture of an entire reservoir or field is obtained by using detailed estimates on a relatively small part of the reservoir as a criterion for the entire reservoir. Instead, the field as a whole should be studied before resolving it into smaller parts. By exchange of information it would be possible to examine the reservoir in its entirety and then estimate proportionate parts from data that were based on more accurate reservoir conditions and performance. By an exchange of information we refer to factual data about a field which is more or less of public record, such as: cumulative production, gas-oil ratios, water production, bottom-hole pressures, which are obtainable in the states operating under conservation laws; also, electrical logs, drillers' logs, core analyses, p.v.t., and scientific data which may be exchanged at the option of the operator.

Many of us have had personal experience and can remember well when reserve estimates were regarded as more or less unessential and only to be made under duress, for such purposes as lawsuits, or in connection with federal depletion, and other tax work. Within the past decade there has been a growing tendency on the part of a few individual operators to maintain continuously a program which includes a study of reserve estimates. In some cases these studies include only properties owned by the operator making the study; in other cases the studies are more complete and include not only the property of the company making the study but principal ownerships and "others" as a group.

[1] Read before the Association research committee conference on "Estimating Petroleum Reserves," H. F. Wright and D. V. Carter, leaders, at Dallas, March 21, 1944. Manuscript received, April 4, 1944. Mimeographed copies (9 pages each) of an outline of the conference on estimating reserves prepared by William L. Horner and Charles H. Pishny, discussion leaders, are available at A.A.P.G. headquarters, Box 979, Tulsa, Oklahoma.—M. G. Cheney, chairman research committee.

[2] Magnolia Petroleum Company.

In other words, reserve estimate studies run the full gamut from small groups of individual properties to all fields in several states distributed to various company ownerships. In the latter cases it is possible to make analyses which will show the approximate annual change in reserve position of the operators to which the ownership distribution is made. It is likewise possible to obtain valuable statistics showing the trends and reserve changes industry-wide, or by states, areas, and fields. Complete annual surveys make it possible to segregate new oil found by extensions as well as new oil found by discovery of new zones in old fields and also the outright new discoveries. Many other interesting conclusions can be drawn. For example, each year's group of outright new field discoveries for any state or area may be graphed, for the purpose not only of showing the upward or downward trend in reserve discovery, but also for the purpose of showing the revisions for individual areas resulting from added reservoir data and more complete field development.

All of us are aware of the importance that refinery and chemical development have played in the utilization of all forms of crude hydrocarbons. Consequently, with this increased ability to utilize all forms of hydrocarbons, attention has rapidly been focused upon the need for reserve estimates of natural gas, for both the ordinary low-pressure type gas, and gas secured from high-pressure reservoirs which yield retrograde type liquids. The retrograde type high-pressure reservoirs ordinarily produce appreciable quantities of condensate. This type of reservoir is becoming more common. The rate and value of production of gas and condensate from this type of reservoir has assumed great importance.

All of this means that reserve estimates of all types of hydrocarbons will be more completely utilized, required, and needed after the war. In fact, a vast improvement has been made in their utilization within the last 6 or 8 years. This utilization has been accelerated by the need for certain specialized refined products such as the 100-octane gasoline used in connection with the war effort. Competitive economic pressure will make reserve estimates for all types of hydrocarbons essential.

Many of the geologists and some operators do not fully appreciate the application of the manifold uses of reserve estimates for various types of crude hydrocarbons. All of us are familiar with the custom of being meticulous in taking physical inventory of tangible equipment and property in the field, which of course is required by the ad valorem taxing authorities who insist on this inventory. Likewise the accounting departments are extremely careful and take considerable pride in their accuracy in all forms of accounting. However, it would appear that not enough attention has been given to making and using hydrocarbon reserve estimates generally throughout the oil and gas industry. We can not forget that the whole objective of a producing organization in its exploration work is in the increasing of its reserve position or as a minimum—the maintenance of its reserve position as against its withdrawal. Increasing the efficiency of recovery will help accomplish this end. All other operations are simply accessory to achieving the principal objective of finding and producing hydrocarbons, for without adequate hydrocarbons, pipelines, refineries, and marketing facilities are of no value. Therefore, it would seem very logical that an annual inventory be taken to determine the status of progress made by an operator's reserve position. If desired, interesting analyses and comparisons can be made in connection with the amount of money expended for any year, in order that an operator can ascertain his competitive position with respect to the industry. The longer time that reserve estimates are made, the more possible it is to arrive at better average figures to increase their accuracy concerning the cost of finding or purchasing crude hydrocarbon reserves.

Reserve estimates are valuable in connection with analyzing the predominant type of producing reservoir which any operator may own. For example, if an operator is fortunate enough to have all of his properties located in reservoirs subject to active water drive, he can expect his estimated future rate of production to be of a sustained nature and quite likely he will be in the enviable position of having a greater percentage of his oil recovered under natural flow conditions than if his properties were concentrated in the gas cap or

two-phase type of reservoir. The entire reserve picture has become more reliable because of those who follow the technological development of reservoir information. This includes adequate, periodic, and detailed surveys of reservoir behavior in order that the accuracy of reserve studies can be increased. Additional information thus derived often compels reserve revisions. The development of new and better engineering and geological techniques are necessary for improving the correctness of reserve estimate studies. The geologist, as well as the engineer, is in a position to gain experience and to acquire and accumulate important basic data which are necessary in the making of reliable and reasonable reserve estimates. Coöperation between the sciences of geology and engineering can greatly facilitate the accuracy of estimating reserves. Irrespective of the facts involved in a reserve estimate, there are still factors existing that remain unknown; consequently, experience and judgment are highly important.

The uses of reserve estimates within an organization, as already indicated, are many; some of the important uses are the following.

1. To check whether or not the operator is in a better or worse position than in the preceding fiscal year after having expended a definite sum of money and after considering the withdrawals.

2. To analyze his reserve position in relation to competitive operators.

3. To analyze the reserves of various types of crude oils with respect to the standpoint of refinery efficiency and their market demands.

4. Reserve estimates are extremely valuable, particularly so when used in conjunction with estimates of availability for a company in its pipeline and refinery operations. The matter of deciding the size of a pipeline and whether or not it should be constructed at all depends primarily and from an economic standpoint on the amount of oil and the rate at which it can be recovered and transported.

5. Reserve estimates have several important uses for an operator in both ad valorem tax and depletion determination.

6. Reserve estimates are valuable in connection with the geological and exploration departments. These statistics can be used in determining the results to date for a stratigraphical zone or geological province, either in a local area or in a wider sense, for a geological basin. They are a help in working out the future probabilities in some cases based on history or the result of discoveries at a definite time; however, this approach should not be regarded as a final determination of the potentialities of the area under study.

7. Reserve estimates are invaluable from the standpoint of the production department's and engineering department's analysis of the efficiency of individual lease operations in comparison with recovery obtained by offset properties. They are necessary from the standpoint of estimating primary and secondary recoverable oil and whether or not certain producing properties are fit subjects for attempting secondary-recovery operations and the method to be employed.

8. Reserve estimates are necessary in connection with drainage between properties.

9. Reserve estimates are an important necessity in certain types of litigation.

10. In order for an operator to establish and protect his share in a reservoir and therefore demand and receive his fair share of recovery in those states actively regulating the rate of withdrawals, it is essential for such operator to know and be able to prove his reserves. This is becoming more and more essential.

Immediate results of a statistical reserve program can not be expected any quicker than those of any other exploratory program, inasmuch as it will require a preliminary period wherein it is necessary to acquire basic information for an effective analysis.

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VOL. 28, NO. 5 (MAY, 1944), PP. 633-634

REVIEWS AND NEW PUBLICATIONS

*Subjects indicated by asterisk are in the Association library, and are available, for loan, to members and associates.

RECENT PUBLICATIONS

CALIFORNIA

*"Geology of the San Benito Quadrangle, California," by Ivan F. Wilson. *California Jour. Mines and Geology*, Vol. 39, No. 2 (San Francisco, April, 1943) (Received, March, 1944), pp. 183–270; 30 figs.

"Eocene Formations and Fossils of Coalinga Anticline," by Ralph Stewart. *U. S. Geol. Survey Prelim. Chart 1*, Oil and Gas Inves. Ser. (April, 1944). Five graphic sections and a sketch map. For sale by the Director of the Geological Survey, Washington 25, D. C. Price, $0.10.

CHINA

*"Petroleum Possibilities in Szechuan Province, China," by J. Marvin Weller. *Oil Weekly*, Vol. 113, No. 5 (Houston, April 3, 1944), pp. 38–40; 2 figs.

COLORADO

*"Paleozoic Stratigraphy of the Sawatch Range, Colorado," by J. Harlan Johnson. *Bull. Geol. Soc. America*, Vol. 55, No. 3 (New York, March, 1944), pp. 303–78; 11 pls. 7 figs.

ENGLAND

*"The Origin and Structure of the Lower Visean Reef-Knolls of the Clitheroe District, Lancashire," by Donald Parkinson. *Quar. Jour. Geol. Soc. London*, Vol. 99, Pts. 3–4 (January 31, 1944), pp. 155–68; 3 figs., 1 pl. Geological Society of London, Burlington House, Piccadilly, W. 1, London. Price, 7s, 6d.

GENERAL

*"Reflection Seismograph Performance along the Gulf Coast," by E. E. Rosaire. *Oil Weekly*, Vol. 113, No. 6 (Houston, April 10, 1944), pp. 16–24; 6 figs., 3 tables.

*"Our Petroleum Resources," by Wallace E. Pratt. *Mining and Metallurgy*, Vol. 25, No. 448 (New York, April, 1944), pp. 222–24.

*"Review of Petroleum Geology in 1943," by F. M. Van Tuyl *et al. Quar. Colorado School of Mines*, Vol. 39, No. 2 (Golden, April, 1944). 127 pp., 4 photographs. Price, $1.00, postpaid.

*"Geological Developments in the Southeastern Gulf Coastal States," by H. R. Brankstone. *Oil and Gas Jour.*, Vol. 42, No. 50 (Tulsa, April 20, 1944), pp. 40–41; 2 figs.

GEORGIA

"Geology of the Coastal Plain of Georgia," by C. W. Cooke. *U. S. Geol. Survey Bull. 941* (1943 (1944)). 121 pp., 1 pl., 1 fig. Sold by Supt. Documents, Govt. Printing Office, Washington, D. C. Price, $1.25.

ILLINOIS

*"Lower Ordovician and Cambrian Oil Possibilities in Illinois," by Stewart Folk. *Oil Weekly*, Vol. 113, No. 3 (Houston, March 20, 1944), pp. 13–15; 1 table, 2 figs.

"Subsurface Structure and Oil Possibilities of Parts of Clay, Marion, and Wayne Counties," by William H. Easton. *Illinois Geol. Survey Illinois Petroleum 48* (Urbana, March, 1944). 8 pp., 2 figs.

KANSAS

*"Reconnaissance of Pleistocene Deposits in North-Central Kansas," by Claude W. Hibbard, John C. Frye, and A. Byron Leonard. *Kansas Geol. Survey Bull. 52,* Pt. 1 (Lawrence, February 20, 1944), pp. 1–28, Figs. 1–2, Pls. 1–2.

*"Ground-Water Conditions in the Neosho River Valley in the Vicinity of Parsons, Kansas," by Charles C. Williams. *Ibid.*, Pt. 2 (March 15, 1944), pp. 29–80, Figs. 1–9, Pls. 1–3.

LOUISIANA

*"Future Louisiana Oil Fields," by Henry V. Howe. *Oil,* Vol. 4, No. 2 (New Orleans, March, 1944), pp. 22–24; 4 maps.

*"Review of Petroleum Production in Louisiana for 1943," by J. Huner, Jr., L. C. Aycock, and P. M. Lyons. *Ibid.*, pp. 31–37.

MONTANA

*"Early Upper Cambrian Faunas of Central Montana," by Christina Lochman and Donald Duncan. *Geol. Soc. America Spec. Paper 54* (New York, March 6, 1944). 181 pp., 19 pls., 2 figs.

OHIO

*"Middle Devonian Bone Beds of Ohio," by John W. Wells. *Bull. Geol. Soc. America,* Vol. 55, No. 3 (New York, March, 1944), pp. 273–302; 1 pl., 14 figs.

*"Some Structural Features of Ohio," by Karl Ver Steeg. *Jour. Geol.*, Vol. 52, No. 2 (Chicago, March, 1944), pp. 131–38; 2 figs., 4 tables.

PENNSYLVANIA

*"Middle Ordovician of Central Pennsylvania II," by G. Marshall Kay. *Jour. Geol.*, Vol. 52, No. 2 (Chicago, March, 1944), pp. 97–116; 18 figs., 11 tables.

TURKEY

*"The Marine Oligocene of Gaziantep, Southern Turkey," by V. Stchepinsky. *Maden Tetkik Arama Enstit. Mecmuasi,* Sene 8, Sayi 2/30 (Ankara, 1943). Bull. Mining Institute of Turkey. Pp. 223–35, in Turkish, 4 pls. of fossils. Pp. 236–48, in French.

*"The Micro-Faunae of the Lower and Middle Eocene of Raman Dag Well No. 2 (Southeastern Turkey)," by S. W. Tromp. *Ibid.* Pp. 249–50, in Turkish, 4 charts. Pp. 251–53, in English.

*"The Value of Drilling Speed Data for Well Correlations and Stratigraphic Classifications," by S. W. Tromp. *Ibid.* Pp. 284–86, in Turkish, 1 chart. Pp. 286–87, in English.

ASSOCIATION DIVISION OF PALEONTOLOGY AND MINERALOGY

**Journal of Sedimentary Petrology* (Tulsa, Oklahoma), Vol. 14, No. 1 (April, 1944).

"Significance of Texture and Density of Alluvial Deposits in the Middle Rio Grande Valley," by Stafford C. Happ.

"Errors of Sampling Sands for Mechanical Analysis," by Gordon Rittenhouse and Mark P. Connaughton.

"Beach Markings Made by Sand Hoppers," by K. O. Emery.

"Petrology of the Pennsylvanian Cycles of the Saint Louis Area," by Albert J. Frank.

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VOL. 28, NO. 5 (MAY, 1944), PP. 635-682, 6 FIGS.

THE ASSOCIATION ROUND TABLE

TWENTY-NINTH ANNUAL MEETING
BAKER HOTEL, DALLAS, TEXAS
MARCH 21, 22, 23, 1944

The twenty-ninth annual meeting of the Association convened on March 21, 22, and 23, 1944, in the Baker Hotel, Dallas, Texas, at the invitation of the Dallas Petroleum Geologists. As customary, the Society of Economic Paleontologists and Mineralogists and the Society of Exploration Geophysicists held their annual meetings at the same time and place, coöperating to make another joint annual war-time conference. For the third year, these three exploratory branches of the oil industry again met and grappled with problems of discovery and operation—problems aggravated by the demands of a world confused in conflict.

The mezzanine of the Baker was filled to overflowing. On Tuesday, March 21, committees and research groups occupied the several meeting rooms on the Commerce Street side, while the geophysicists held their technical sessions in the Crystal Ball Room. (Ball room is a present misnomer; dances and banquets are affairs of the past and the future.) The registration tables mid-way of the mezzanine were all but hidden by hundreds of geologists, geophysicists, and paleontologists. The large Lounge at the Akard and Jackson Street corner was well filled with exhibit booths and map displays, extending into the Foyer, adjoining the Crystal Room, where the technical program was being presented.

On Wednesday, March 22, the three societies met in joint session, listening to the presidential addresses and the featured talks by representatives of Government services from Washington, D. C. This was the high tide of the meeting; 1,350 persons signed registration cards, but at least 1,500 must have thronged the technical sessions, the exhibit rooms, and the Lobby floor. Name-plate badges (the prized insignia of the habitual convention delegate, and perhaps a real incentive to register one's presence) were absent this year in deference to the well intended effort to avoid undue attention at a time when all accommodations and facilities were already sorely taxed.

On Thursday, March 23, the S.E.P.M. held its meeting in the Texas Room, and the A.A.P.G. continued its sessions in the Crystal Room with papers of general interest in the forenoon and a symposium on Well Spacing in the afternoon.

Specialized research conferences on Tuesday and two well attended evening lectures on Tuesday and Wednesday added emphasis to the old and unsolved problem of the origin of oil.

ELECTION

A.A.P.G. officers elected for the new year ending in spring of 1945 are: president, IRA H. CRAM, Pure Oil Company, Chicago, Illinois; vice-president, WARREN B. WEEKS, Phillips Petroleum Company, Shreveport, Louisiana; secretary-treasurer, ROBERT E. RETTGER, Sun Oil Company, Dallas, Texas; editor, GAYLE SCOTT, Texas Christian University, Fort Worth, Texas.

S.E.P.M. officers for the new year are: president, DONALD D. HUGHES, Stanford University, California; vice-president, HERSHAL C. FERGUSON, Houston, Texas; secretary-treasurer, H. B. STENZEL, Bureau of Economic Geology, Austin, Texas.

S.E.G. officers newly elected are: president, WILLIAM M. RUST, JR., Humble Oil and Refining Company, Houston, Texas; vice-president, HENRY C. CORTES, Magnolia Petroleum Company, Dallas, Texas; secretary-treasurer, W. H. TAYLOR, Petty Geophysical Engineering Company, Houston, Texas; editor, J. A. SHARPE, Stanolind Oil and Gas Company, Tulsa, Oklahoma.

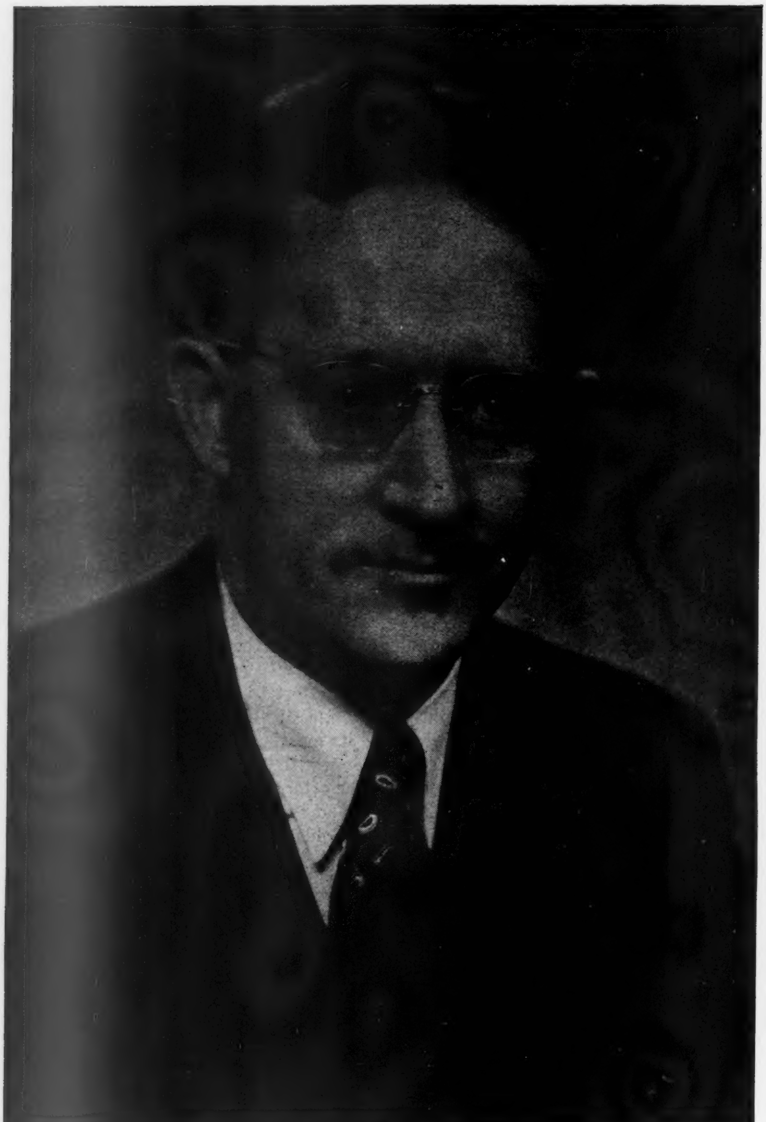


Photo by Koehne

FIG. 1.—Ira H. Cram, president of the Association, elected at Dallas.

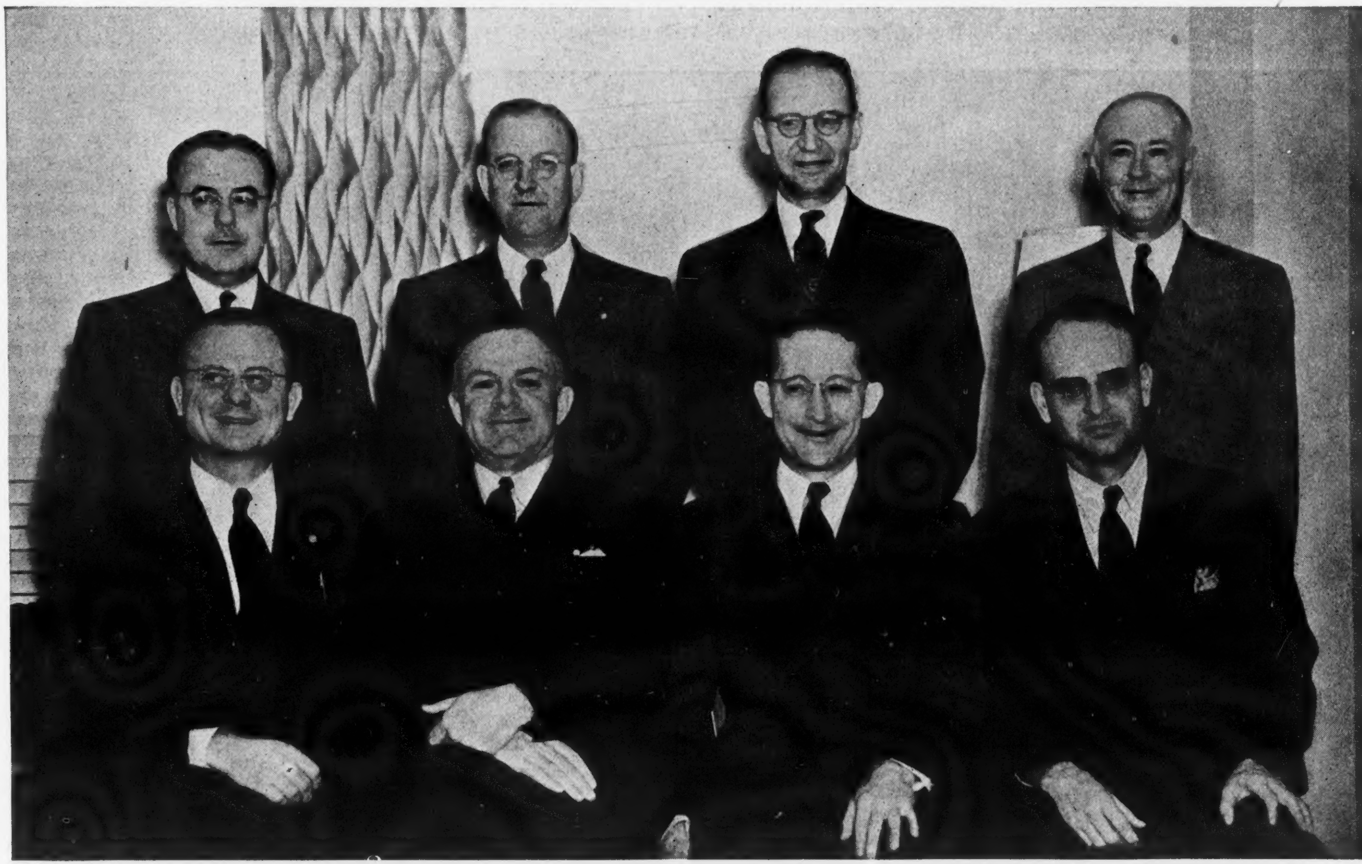


FIG. 2.—Outgoing and incoming executive committees of the Association. Incoming officers, seated, left to right: ROBERT E. RETTGER, secretary-treasurer; GAYLE SCOTT, editor, IRA H. CRAM, president; WARREN B. WEEKS, vice-president. Outgoing officers, standing, CAREY CRONEIS, editor; ROBERT W. CLARK, vice-president; A. RODGER DENISON, president; FRITZ L. AURIN, past-president.

Fig. 3.—Joint technical session of A.A.P.G., S.E.P.M., and S.E.G., in Crystal Ball Room, Baker Hotel, Dallas, Texas, March 22.

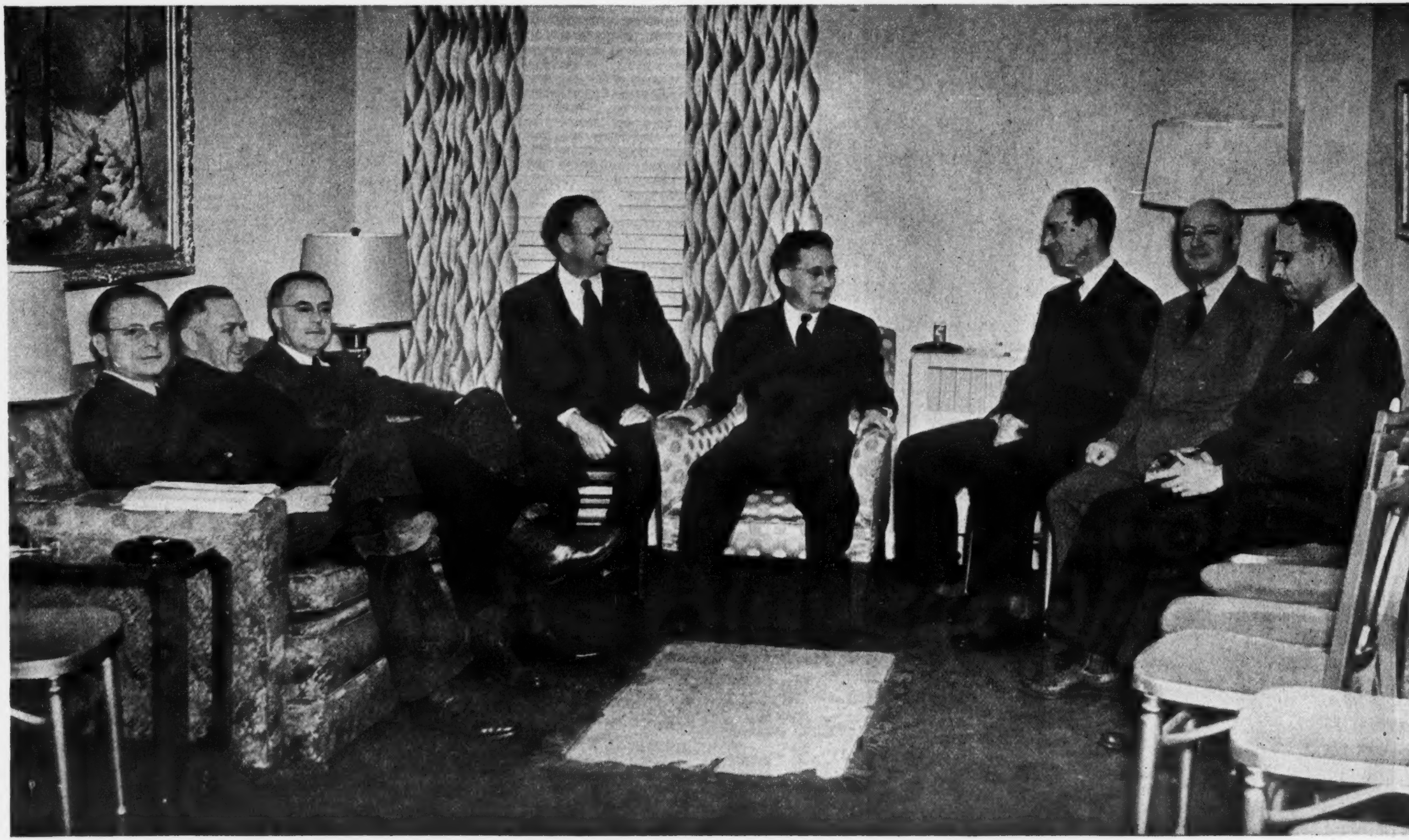


FIG. 4.—Old and new officers in executive committee meeting, Dallas, March 23. Left to right: Rettger, Scott, Croneis, Clark, Cram, Denison, Aurin, Weeks.

FIG. 5.—Part of map displays and exhibits in Lounge, Mezzanine Floor, Baker Hotel, Dallas, 29th annual meeting.

Courtesy of the Dallas Morning News

FIG. 6.—At the ceremony of the presentation of certificates of honorary membership in the Association. Left to right: W. E. Wrather, honorary member elected in 1943; A. Rodger Denison, president; Charles E. Decker, honorary member elected in 1927.

HOST SOCIETY AND CHAIRMEN FOR ARRANGEMENTS

The Dallas Petroleum Geologists, the hosts of the joint annual meeting, their officers, and various chairmen deserve high praise for their successful efforts in making the meeting a thoroughly enjoyable and satisfactory event.

The officers of the Dallas Petroleum Geologists are: president, JOSEPH M. WILSON, Continental Building; past-president, S. A. THOMPSON, Magnolia Petroleum Company; vice-president, HENRY C. CORTES, Magnolia Petroleum Company; secretary-treasurer, H. C. VANDERPOOL, Seaboard Oil Company; member of executive committee, CECIL H. GREEN, Geophysical Service, Inc.

The committee chairmen follow.

Technical Program, F. H. LAHEE and S. A. THOMPSON

Local Arrangements

General, JOSEPH M. WILSON
Technical, CHARLES B. CARPENTER
Hotels and Housing, EUGENE MCDERMOTT
Registration, LEWIS W. MACNAUGHTON
Reception, DILWORTH S. HAGER
Educational Exhibits, EDGAR KRAUS
Finance, H. C. VANDERPOOL
Publicity, J. EDWARD MORROW
Publications, SAM M. ARONSON
S.E.P.M., JAMES A. WATERS
S.E.G., CECIL H. GREEN

PAPERS ON ANNUAL PROGRAM

SPECIAL AND PRESIDENTIAL ADDRESSES

1. F. M. VAN TUYL ET AL., Colorado School of Mines, Golden, Colorado
   Review of Petroleum Geology in 1943
2. F. H. LAHEE, Sun Oil Company, Dallas, Texas
   Wildcatting in 1943
3. J. HARLAN JOHNSON, Colorado School of Mines, Golden, Colorado
   Paleontology, Petroleum and the Search for Oil (S.E.P.M. Presidential Address)
4. R. D. WYCKOFF, Gulf Research and Development Company, Pittsburgh, Pennsylvania
   Geophysics Looks Forward (S.E.G. Presidential Address)
5. A. R. DENISON, Amerada Petroleum Corporation, Tulsa, Oklahoma
   A Challenge to Geology (A.A.P.G. Presidential Address)
6. W. E. WRATHER, Director, U. S. Geological Survey, Washington, D. C.
   The United States Geological Survey in War-Time
7. E. DEGOLYER, Petroleum Reserves Corporation, Washington, D. C.
   Notes on the Near East
8. LT. COL. GERALD FITZGERALD, Army Air Corps, Washington, D. C.
   Trimetrogon Photography for Reconnaissance Mapping
9. F. H. HARBISON, Labor Counsellor, Petroleum Administration for War, Washington, D. C.
   Status of Manpower and Selective Service

GENERAL PAPERS

1. ESTHER R. AND PAUL L. APPLIN, Consulting Geologists, Fort Worth, Texas
   Regional Subsurface Study and Structure of Florida and South Georgia
2. G. C. GESTER, Standard Oil Company of California, San Francisco, California
   World Crude Oil Reserves
3. JOHN L. RICH, University of Cincinnati, Ohio
   Prospective Oil Territory of South America as Indicated by Regional Geology
4. J. MARVIN WELLER, Illinois Geological Survey, Urbana, Illinois
   Outline of Chinese Geology

SYMPOSIUM ON WELL SPACING

1. C. W. TOMLINSON ET AL., Ardmore, Oklahoma
   Well Spacing—Its Effects on Recoveries and Profits
2. STUART E. BUCKLEY, Humble Oil and Refining Company, Houston, Texas
   Petroleum Reservoir Efficiency and Well Spacing
3. M. G. CHENEY, Anzac Oil Corporation, Coleman, Texas
   Factors to be Considered in Well Spacing

SPECIAL EVENING LECTURES

1. A. I. LEVORSEN, Consulting Geologist, Tulsa, Oklahoma
   Survey of Geology Students
2. ROLAND F. BEERS, Massachusetts Institute of Technology
   Radioactivity and Organic Content of Some Paleozoic Shales
3. T. S. OAKWOOD, Pennsylvania State College
   The Rôle of Chemistry in the Origin of Oil

PAPERS ON S.E.P.M. PROGRAM

1. J. HARLAN JOHNSON, Colorado School of Mines, Golden, Colorado
   Calcareous Algae as Useful Microfossils
2. W. S. ADKINS, Shell Oil Company, Inc., Houston, Texas
   Mortoniceras vespertinum (Morton)—*Lower Cretaceous Ammonite, Genotype*
3. S. W. LOWMAN, Shell Oil Company, Inc., Houston, Texas
   Progress Report on Relationship of Facies to Distribution of Foraminifera in Northern Gulf of Mexico Region
4. H. B. STENZEL, Bureau of Economic Geology, University of Texas, Austin, Texas
   Cretaceous Crabs, Lobsters, and Shrimps from Vicinity of Dallas
5. BRUCE L. CLARK, University of California, Berkeley, California
   Problems of Speciation and Correlation as Applied to Marine Cenozoic
6. FRANK V. STEVENSON, University of Chicago, Chicago, Illinois
   New Aspects of Devonian of New Mexico
7. F. B. PLUMMER, University of Texas, Austin, Texas
   Formation of Travertine and Fresh-Water Limestones

PAPERS ON S.E.G. PROGRAM

1. NASH H. MILLER, United Geophysical Company, Pasadena, California
   Notes on Well Shooting Data
2. JOHN A. GILLIN, R. D. ARNETT, and E. D. ALCOCK, National Geophysical Company, Dallas, Texas
   The Correlation Refraction Method of Seismic Surveying
3. PHIL P. GABY, Geophysical Service, Inc., Fresno, California
   A New Type of Seismic Cross Section Wherein Accuracy of Representation is Rendered Insensitive to Velocity Error
4. PAUL H. BOOTS, Gulf Research and Development Company, Pittsburgh, Pennsylvania
   Geophysical Survey of Kuwait, Persian Gulf
5. C. HEWITT DIX, United Geophysical Company, Pasadena, California
   Interpretation of Well Shot Data II
6. MONROE W. KRIEGEL, Carter Oil Company, Tulsa, Oklahoma
   Analysis of Hydrocarbons in the Presence of Nitrous Oxide
7. NORMAN RICKER, Carter Oil Company, Tulsa, Oklahoma
   Computation of Output Disturbances from Amplifiers for True Wavelet Inputs
8. ALFRED WOLF, Geophysical Research Corporation, Tulsa, Oklahoma
   Motion of a Rigid Sphere in an Acoustic Wave Field
9. SIGMUND HAMMER, L. L. NETTLETON, and W. K. HASTINGS, Gulf Research and Development Company, Pittsburgh, Pennsyvlania
   Gravimeter Prospecting for Chromite in Cuba
10. J. C. BARCKLOW, Lane-Wells Company, Oklahoma City, Oklahoma
    Scope and Utilization of Radioactivity Logs
11. GLENN M. MCGUCKIN, Magnolia Petroleum Company, Dallas, Texas
    History of the Geophysical Exploration of the Cameron Meadows Dome, Cameron Parish, Louisiana
12. ROBERT E. SOUTHER, Baroid Sales Division, National Lead Company, Tulsa, Oklahoma
    Application of Fluid Logging
13. H. B. PEACOCK, Geophysical Service, Inc., Houston, Texas
    Geophysical History of Cayuga Field, Anderson County, Texas
14. R. MAURICE TRIPP, Colorado School of Mines, Golden, Colorado
    Radon Survey of the Fort Collins Anticline

MINUTES, TWENTY-NINTH ANNUAL BUSINESS MEETING BAKER HOTEL, DALLAS, TEXAS MARCH 22–23, 1944

A. RODGER DENISON, *presiding*

The meeting was called to order at 12 M., April 22, 1944, by A. Rodger Denison, president.

1. *Nomination of officers.*—The president called for nomination of officers of the Association for the ensuing year. The following nominations were made.

For president: IRA H. CRAM, nominated by George S. Buchanan
HAL P. BYBEE, nominated by Gentry Kidd

For vice-president: WARREN B. WEEKS, nominated by John G. Bartram

For secretary-treasurer: ROBERT E. RETTGER, nominated by Charles B. Carpenter

For editor: GAYLE SCOTT, nominated by M. Gordon Gulley

2. *Ballot committee.*—The president appointed a ballot committee, composed of Frank R. Clark, chairman, Morgan J. Davis, and Richard G. Reese.

3. *Resolutions committee.*—The president appointed a resolutions committee composed of C. L. Moody, chairman, Robert E. Garrett, Edward A. Koester, Phillip F. Martyn, and James F. Swain.

The meeting recessed until 4:00 P.M., April 23.

The recessed meeting was called to order by A. Rodger Denison, presiding, and Robert E. Rettger, acting as secretary.

4. *Report of ballot committee.*—The report of the ballot committee was read by Frank R. Clark, chairman.

Total ballots cast	690
Total ballots mutilated	13
Total ballots counted	677
One ballot failed to cast vote for either presidential candidate	1

For president: IRA H. CRAM	515
HAL P. BYBEE	161
Total votes for president	676
For vice-president: WARREN B. WEEKS	613
For secretary-treasurer: ROBERT E. RETTGER	612
For editor: GAYLE SCOTT	612

5. *Reading of minutes.*—It was moved, seconded, and carried that the minutes of the annual meeting held at Fort Worth, Texas, April 8–9, 1943, be not read since they have been published in the *Bulletin*.

6. *Reports of officers.*—The reports of president Denison, secretary-treasurer Rettger, and editor Croneis were read (Exhibits I, II, and III).

7. *Report of resolutions committee.*—The report of the resolutions committee was read by C. L. Moody, chairman (Exhibit IV).

8. *Report of business committee.*—The report of the business committee was read by Orval L. Brace, chairman. It was moved, seconded, and carried that the recommendations be adopted (Exhibit V).

President Denison read the following recommendations of the executive committee.

9. *Affiliation of Southeastern Geological Society.*—The executive committee recommends to the annual business meeting that the Southeastern Geological Society of Tallahassee, Florida, be accepted as an affiliated society of the Association. It was moved, seconded, and carried that the recommendation be adopted.

10. *Affiliation of Yellowstone-Bighorn Research Association.*—The executive committee recommends to the annual business meeting that the Yellowstone-Bighorn Research

Association be accepted as an affiliated society of the Association. It was moved, seconded, and carried that the recommendation be adopted.

11. *Re-incorporation of Association.*—By unanimous vote, the executive committee of the Association recommends to the annual business meeting that the Association be re-incorporated for a period of twenty (20) years in the State of Colorado. It was moved, seconded, and carried that the recommendation be adopted.

12. *Resolution to revise restrictions on well spacing.*—The following resolution was presented by R. S. McFarland.

WHEREAS, the Petroleum Administrator has indicated that he desires to relax war-time restrictions on the petroleum industry as promptly as possible, and

WHEREAS, the restrictions on the producing and drilling operations of the petroleum industry have been for the purpose of controlling the use of critical materials, and

WHEREAS, the supply of tubular steel for use in oil and gas wells is now in excess of current and maximum anticipated demands, even if the industry is able to carry out the program for drilling 24,000 exploratory and development wells in 1944, for which steel has been allocated, and

WHEREAS, the necessity for filing applications and securing approval before drilling operations can be started on locations that conform to State spacing rules but do not conform to the provisions of PAO 11 results in delays that force shutdowns on rigs so that experienced and organized drilling crews are disrupted with a consequent loss in efficiency by drilling rigs, and

WHEREAS, the loss in rig time and efficiency, secured when maintaining an experienced and organized crew in constant operation, has resulted in increasing the time required to drill wells, and

WHEREAS, for the reasons cited above, an easing of existing restrictions by the Petroleum Administrator on drilling of wells will encourage and stimulate exploration and development, and

WHEREAS, the American Association of Petroleum Geologists is vitally concerned in exploration for and development of oil and gas reserves, and desires to bring about conditions favorable to such activities,

NOW, THEREFORE, BE IT RESOLVED, that the Petroleum Administration for War be urged to revise its restrictions on well spacing so that applications and approval will be required only on wells that do not conform to the State spacing orders or wells that are drilled in states which have not established spacing rules, and further that the president of the Association transmit this resolution to the Petroleum Administrator for War and furnish copies to the Interstate Oil Compact and the various State oil and gas regulatory bodies.

It was moved, seconded, and carried that the resolution be adopted.

(The following reports appear as exhibits as part of the minutes.)

I. President, A. Rodger Denison
II. Secretary-treasurer, Robert E. Rettger
III. Editor, Carey Croneis
IV. Resolutions, C. L. Moody, chairman
V. Business, Orval L. Brace, chairman
VI. National service, K. C. Heald, chairman
VII. Publication, J. V. Howell, chairman
VIII. Geologic names and correlations, J. G. Bartram, chairman
IX. Applications of geology, Paul Weaver, chairman
X. Medal award, A. Rodger Denison, chairman
XI. Distinguished lectures, John L. Ferguson, chairman
XII. College curricula in petroleum geology, F. H. Lahee, chairman
XIII. Research, M. G. Cheney, chairman
XIV. National Research Council Division of Geology and Geography, M. G. Cheney, representative

The twenty-ninth annual meeting adjourned at 5:15 P.M.

A. RODGER DENISON, *president* ROBERT E. RETTGER, *secretary*

EXHIBIT I. REPORT OF PRESIDENT

(Year ending March 23, 1944)

This report by tradition has been called the report of the president; it should more properly be called the report of the chairman of the executive committee. While it is true that there are a number of specific duties performed by the president alone, the great majority of decisions are reached by action of the executive committee as a whole.

You will be given reports by the secretary-treasurer and the editor. Their reports will reveal the efficient manner in which these officers have performed their special duties and will show: that our membership continues to grow, that our total assets have substantially increased, and that our publications have maintained their usual high standards.

There are two other members of the executive committee from whom you will not hear, namely, the vice-president and the past-president. I must, therefore, appraise you of the excellent coöperation and the fine individual work done by each of these officers. Vice-president Clark, being located in California, has been in a particularly favorable position to bring to the committee the ideas and opinions of a large group of our membership residing on the West Coast. He is a wise counsellor in Association affairs and has responded promptly and efficiently to every request made of him. Past-president Aurin has by his active continuing interest in Association affairs raised new high standards of achievement for a man in his office. Having during his own tenure of office conducted a questionnaire to determine special skills and talents of our members, he has during the past year made all revisions and additions to this large fund of information. Due to his continuing efforts we now have without question the largest and most complete data on our membership of any society or association in existence. He has in addition been invariably available for meetings and conferences at the call of the president. Travel to such meetings has included one trip to the West Coast and one trip to the East Coast, as well as numerous short trips. He can, I believe, indeed qualify as the most active past-president in the Association's history.

We now turn to a review of the activities of the Association through its executive committee during the past ten months. These items can be divided into three categories.

1. New business undertaken.
2. Progress on old items.
3. Coöperative activities with other organizations and institutions.

I shall confine myself to the more important items in each category. Among the new business are the following.

1. Inventory of exploration personnel, compiling for the first time some figures on how many people—geologists, geophysicists, *et al.*, are employed in petroleum exploration. I shall make references to the results of this survey a little later.

2. Organized the medal award committee and instituted the medal fund. The progress made by this committee is contained in the report of the chairman.

3. Appointed a committee to compile a volume on South American geology. This committee likewise has furnished a report of its activities.

4. Elected two new honorary members and adopted a certificate of membership and new membership card which were presented to all new and old honorary members of the Association in March, 1944.

Among the items on which progress has been made are the following.

1. We have continued to aid those of our members who are sponsoring the formation of a national geological organization, to bring together for unity of purpose and action all geological societies and through them all geologists.

2. We have continued through our national service committee to assist geologists and to improve the standing of geology. The work of the committee is given in detail in the report of its chairman.

3. Continued to underwrite the finances of the distinguished lecture committee. The activities this of committee are covered in the chairman's report.

Among the items of coöperation with governmental and public agencies and institutions are these.

1. Assisting the U. S. Geological Survey in organizing its program of work to aid the exploration branch of the oil industry.

2. Furnished the Army, Navy, and other branches of the Armed Forces with the names of our members with foreign experience and those who might supply maps of foreign areas, as well as supplying other data.

3. Supplied the Department of Justice Economic Warfare Section and other departments with information of a confidential nature.

4. Donated to National Geological Survey of China, through the American Embassy at Chunking, two volumes of our publications.

5. Coöperated with the Division of Geology and Geography, National Research Council, in the organization of a committee to study manpower problems. The work of this group will be touched upon a little later.

6. Conferred with and advised the National Roster of Scientific and Specialized Personnel on (a) an improved "check list" of geology and geophysics, and (b) a definition of the profession of geology and an enumeration of the qualifications for the profession. The completed definition of the profession was published in the February, 1944, *Bulletin*.

7. Continued our financial and other coöperation with various societies and individuals in the compilation of such maps as

a. The glacial map of North America

b. The geological map of North America

c. The tectonic map of the United States. It is anticipated that the tectonic map will be ready in 1944. It will be distributed from Association headquarters.

This outline of Association affairs is a record of progress and achievement—things accomplished. The list is rather long and we can, I believe, in all modesty, be proud of the record. I do not care to leave you, however, with the impression that we have accomplished everything we set out to do. Some efforts were failures and other than to say we have profited by our mistakes, I shall make no elaboration. Other items have received the thoughtful consideration of this executive committee and will be passed on to the next committee with the hope that they may successfully carry out these plans and projects.

Some elaboration seems desirable of one or two of the items listed in the outline of Association activities. Perhaps the action which has and will have for the duration of the war the greatest effect on geologists was the inventory of personnel in petroleum exploration accomplished last May and June by the executive committee, ably assisted by the national service committee and several of our district representatives. This inventory revealed for the first time the various types of work done by our members, and indicates the number working for industry, for Federal and State agencies, and others both in the United States and abroad. This analysis was published in the November, 1943, *Bulletin*. This inventory furthermore gave for the first time a partial answer to the number of geologists, paleontologists, and geophysicists employed in petroleum exploration, and the needs for additional personnel. With these figures and those from other sources W. B. Heroy, then director of Reserves for the Petroleum Administration for War, was able to demonstrate in a report to the War Manpower Commission in June, 1943, that there was an acute and critical shortage of geologists and geophysicists for petroleum exploration. The recognition of the shortage led to the inclusion of geologists in the list of critical occupations in Selective Service L.B.M. 115 (as amended August 16, 1943). The inclusion of geologists in this list gave recognition of the essential nature of the geologist's work in the war effort and led to the retention in industry of a large number of the men who are so vitally needed.

A second item of prime interest for geologists arose from the committee on manpower problems organized by W. W. Rubey, chairman, Division of Geology and Geography, in which Association members are participating. As a result of information furnished by W. B. Heroy, chairman of this committee, and the work of Mr. Rubey, the study of geology was included in Selective Service A.O.B. 33–6 (as amended January 6, 1944). This bulletin set up national quotas for students' deferments in engineering, chemistry, physics, geology, and geophysics.

Prior to this bulletin no student of geology or geophysics could be deferred to finish his college course. The quota for the two subjects is very small and will not go far toward supplying the needs of industry, but we now have the study of geology recognized as a subject which deserves special action to insure a continued supply of trained personnel.

I should be remiss in my duty if I did not call to your attention the work of our standing and special committees and the trustees of our special funds. The chairmen and members of these committees constitute individually and collectively an ever increasing influence in the affairs of the Association by keeping alive and current throughout the year the progress on problems and studies in petroleum geology. Their work is indeed an important factor in the continued growth of our Association and in the advancement of geology.

You are familiar through their annual reports with the work of these committees. Without detracting from the accomplishments of the others I desire to mention in particular the work of a few.

In volume of work done and diversity of interest the research committee is outstanding. This year under the able leadership of M. G. Cheney this committee has continued with work previously initiated and has started new study and conference groups which constitute a real contribution to petroleum geology.

The national service committee now finishing its third year has under the leadership of K. C. Heald, chairman, continued and enlarged its already fine record of achievement in rendering service to the membership both in and out of the Armed Forces. It has provided the executive committee with up-to-date carefully analyzed and digested information on the every changing character of the opportunities and possibilities of service which geologists may render in the war effort.

The distinguished lecture committee now finishing its second full year as one of our special committees has indicated fully the wisdom of those who initiated and organized its functions. Under the able leadership of John L. Ferguson it has brought to the local societies an opportunity to hear the finest talent in geology. The tours of the speakers are so completely and minutely planned for comfort and convenience that they are the occasion for infinite praise by those who make the trips. In addition to bringing to the petroleum geologist the newest and best in lectures, a reciprocal benefit is being enjoyed in large measure by the Association and petroleum geology in the good will inspired in those distinguished lecturers. This will, I believe, lead to an even better understanding and appreciation by geologists in other lines of endeavor of the high quality and large volume of scientific work being done by geologists in the petroleum industry.

The committee for publications under the chairmanship of J. V. Howell was assigned the new duty this year of selecting authors and soliciting papers on annual development. Formerly this was handled by an individual who was appointed by the chairman of the technical program committee and, therefore, lacked the year to year continuity which is desirable. This committee has formulated a series of suggestions to guide the authors of these development papers which when fully applied will lead to greater uniformity and more complete reporting of the new and interesting developments of the previous year.

I can not close a recitation of the particularly helpful service enjoyed by the president and the executive committee without mentioning the large measure of efficient aid rendered by our business manager, J. P. D. Hull, and his headquarters staff. In addition to

carrying on the routine duties of the Association in the same efficient manner which he inaugurated in 1926, Mr. Hull has furnished sound counsel and advice on many items of Association business, as well as performing for the committee many extra tasks and duties arising from special circumstances. The president, being located in Tulsa at headquarters, has been the special recipient of this helpful aid. Indeed this aid has on frequent occasions transformed what could have been an overwhelming burden into a pleasurable task.

I should also like to acknowledge the splendid coöperation which has been enjoyed throughout the years from the membership at large—no request however large or small for aid or assistance in Association affairs has ever been refused. With this spirit among the membership there can be no doubt as to the future progress of the Association.

No person can serve as president of this organization without becoming a believer in, and an ardent salesman for the Association and its future. During my tenure of office I have come to realize as never before the outstanding position held by this group of professional geologists not only in its service to industry but in the realm of scientific and technical societies. We are the largest and only organization in the world whose interests are devoted to a single application of science to industry. We are rated by kindred societies as young, progressive, and energetic, constantly maintaining a high standard of scientific effort while expanding our usefulness to our members and to geology as a whole.

Geology has never had a wider acceptance in industry, and the importance of the geologist and the demand for his services have never been greater. In the prophetic words of Ed Owen in his presidential report in 1942,

> Our potentialities for usefulness are rapidly increasing. The Association can already be proud of the war record of many of its members. Their intimate understanding of field conditions over the whole world, and their ability to perform a wide diversity of technical tasks, endow our men with capabilities for military and civilian service which insures the constantly growing brilliance of their achievements.

More than 600 of our members are in the Armed Forces, many of them abroad on the battlefields throughout the world exposed to the dangers and hazards of the elements and the enemy. Our fervent hope is that the day may soon come when these men may return to the pursuits of peace.

A. Rodger Denison, *president*

Exhibit II. Report of Secretary-Treasurer

(Year ending March 1, 1944)

Membership.—Membership in the Association continued its upward trend during 1943 and 1944. Since passing through the depression years of 1933, 1934, and 1935, when our membership decreased, we have shown a steady gain. Total membership is now at a new maximum of 4,109. During the year 297 new members and associates were added to the rolls and 111 were lost because of various reasons, making a total net gain of 186 members. At the present time there are 98 applications for membership on hand. Associate members total approximately 30 per cent of the membership as compared to 22 per cent in 1940. This is due to the large number of young men being accepted during the last few years.

Many of our members are in the armed forces and have taken advantage of the ruling in the by-laws which allows them to retain membership without the payment of annual dues. The total number thus retaining membership is 174.

During the year 19 of our members have passed away. Their loss will be keenly felt by the Association. Three of these were honorary members. They are as follows.

MEMBERS AND ASSOCIATES DECEASED

From April 1, 1943
Honorary—Smith, George Otis, January 10, 1944
Ulrich, Edward Oscar, February 22, 1944
van der Gracht, Willem Anton J. M. van Waterschoot, September, 1943
Active— Brewer, Charles, Jr., January 2, 1944
Clapp, Frederick G., February 18, 1944
Dickerson, Roy E., February 24, 1944
Fischer, Otto, June 22, 1943
Garrett, Lovic P., December 13, 1943
Kay, Fred H., August 14, 1943
Martin, George C., June 22, 1943
Nomland, J. O., May 7, 1943
Reid, William McCormick, May 11, 1943
Reynolds, Roy A., June 19, 1943
Steubing, W. C., October 28, 1943
Tieje, Arthur J., January 25, 1944
Ward, Freeman, September 14, 1943
Wilson, Homer M., July 14, 1943
Associate—Crumley, Rial Fleming, Jr., July 22, 1943
Reiss, John Walter, June 4, 1943

Tables I, II, and III give data concerning the total membership by years, comparative data of membership, and geographic distribution.

Finances.—The usual annual audit, which was published in the March *Bulletin*, showed a net profit of $13,414.39 as compared with $5,482.27 last year. This larger profit is due mainly to the collection of the Sidney Powers Memorial Medal Fund which now amounts to $5,296.50. Actual profit, exclusive of this fund, was $8,119.89. This is $2,637.62 greater than last year.

The cost of publishing the *Bulletin* was $34,287.92 compared with $43,471.01 last year. This saving was brought about by the reduction in the number of pages printed and in the lower cost of the lighter-weight paper. During the last three years the cost of the *Bulletin* per copy has been reduced from $0.563 to $0.465 (Table VIII).

During the year the Association has purchased $21,600 worth of Government savings bonds. On April 1, 1944, our investment account stood as follows.

U. S. Government bonds	$39,250.00
Industrial bonds	12,529.25
Preferred stocks	6,550.00
Common stocks	21,861.35
Savings account	4,780.85
Total investments	$84,971.45

These investments are divided into several funds as follows.

General fund	$60,282.23
Publication fund	15,544.62
Research fund	2,544.60
Life membership fund	1,600.00
Medal fund	5,000.00
Total investments	$84,971.45

An additional $6,100 has been set aside for the purchase of several high-grade common stocks but to date no actual purchase has been made. It should be mentioned that all investments are made by the executive committee with the aid and advice of a paid financial counsellor and after consultation with the Association's finance committee consisting of three members.

Detailed statements of income and expenses, with comparative figures for 1941 and 1942, are given in Tables IV, V, and VI. Investments as of December 31, 1943 are given in Table VII.

1944 *Budget.*—Table X gives a tabulation of the estimated budget for 1944. With an estimated income of $58,850, a total expenditure of $54,675 is expected. This is $5,580 larger than in 1943 and is due to the item of $5,500 set aside for the tectonic map of the United States now in preparation. This map will be distributed at approximate cost by the Association during the coming year and our investment should be returned.

Executive committee meetings.—During the year executive committee meetings were held as follows.

Fort Worth	April 9, 1943
Tulsa	April 20, 1943
Houston	April 25, 1943
Los Angeles	October 13, 1943
Dallas	January 15, 1944
Dallas	March 20, 1944

Throughout the entire year the officers have been in close contact by mail or telephone and president Denison and past-president Aurin have made several trips to Dallas for consultation with members of the Dallas Petroleum Geologists.

Acknowledgments.—The secretary-treasurer wishes to acknowledge and commend the work of the business manager, J. P. D. Hull, and his office force for the excellence of their services to the Association. All duties and functions of the Tulsa headquarters have been carried out promptly and accurately. He also wishes to thank other members of the executive committee and the members of the finance committee for their excellent coöperation during the entire year.

ROBERT E. RETTGER, *secretary-treasurer*

TABLE I

TOTAL MEMBERSHIP BY YEARS

May 19, 1917	94	March 1, 1931	2,562
February 15, 1918	176	March 1, 1932	2,558
March 15, 1919	348	March 1, 1933	2,336
March 18, 1920	543	March 1, 1934	2,043
March 15, 1921	621	March 1, 1935	1,973
March 8, 1922	767	March 1, 1936	2,169
March 20, 1923	901	March 1, 1937	2,331
March 20, 1924	1,080	March 1, 1938	2,646
March 21, 1925	1,253	March 1, 1939	2,951
March 1, 1926	1,504	March 1, 1940	3,240
March 1, 1927	1,670	March 1, 1941	3,474
March 1, 1928	1,952	March 1, 1942	3,717
March 1, 1929	2,126	March 1, 1943	3,923
March 1, 1930	2,292	March 1, 1944	4,109

TABLE II

COMPARATIVE DATA OF MEMBERSHIP

	March 1, 1943		*March 1, 1944*	
Number of honorary members	13		12	
Number of life members	7		7	
Number of members	3,039		3,129	
Number of associates	864		961	
Total number of members and associates		3,923		4,109
Net increase in membership		206		186
Total new members and associates	263		246	
Total reinstatements	48		51	
Total new members and reinstatements		311		297
Applicants elected, dues unpaid	17		7	
Applicants approved for publication	41		46	
Recent applications	47		45	
Total applications on hand		105		98
Applicants for reinstatement elected, dues unpaid	0		0	
Recent applications for reinstatement	0		4	
Total applications for reinstatement on hand		0		4
Applicants for transfer approved for publication	6		9	
Recent applications for transfer on hand	4		13	
Total applications for transfer on hand		10		22
Number of members and associates resigned	17		3	
Number of members and associates dropped	75		89	
Number of members and associates died	13		19	
Total loss in membership		105		111
Total gain in membership		311		297
Number of members and associates in arrears, previous years	169		139	
Members in arrears, current year	987		484	
Associates in arrears, current year	299		169	
Total number members and associates in arrears, current year		1,286		653
Total number members and associates in good standing		2,468		3,317

TABLE III

GEOGRAPHIC DISTRIBUTION OF MEMBERS

March 1, 1944

Alabama	8	Louisiana	229	Ohio	26
Arizona	3	Maryland	8	Oklahoma	536
Arkansas	19	Massachusetts	17	Oregon	1
California	490	Michigan	47	Pennsylvania	85
Colorado	77	Minnesota	6	Rhode Island	1
Connecticut	6	Mississippi	55	South Carolina	2
Delaware	2	Missouri	29	South Dakota	5
Dist. of Columbia	88	Montana	27	Tennessee	10
Florida	27	Nebraska	14	Texas	1,288
Georgia	4	Nevada	2	Utah	5
Illinois	109	New Hampshire	1	Virginia	17
Indiana	65	New Jersey	12	Washington	12
Iowa	13	New Mexico	34	West Virginia	21
Kansas	181	New York	109	Wisconsin	7
Kentucky	22	North Carolina	4	Wyoming	43
		North Dakota	2		

Total members in United States 3,769

Alberta	44	Ecuador	15	Ontario	6
Angola	1	Egypt	3	Palestine	2
Argentina	19	England	14	Persian Gulf	3
Australia	10	Germany	1	Peru	5
Barbados	1	Haiti	2	Portugal	1
Belgian Congo	1	India	2	Prince Edward Is.	2
Bolivia	1	Iran	1	Quebec	1
Brazil	2	Iraq	1	Saskatchewan	2
British Columbia	1	Japan	1	Scotland	2
British Guiana	1	Java	1	Sumatra	2
Chile	6	Mexico	15	Switzerland	9
China	1	Netherlands	1	Syria	1
Colombia	44	New Brunswick	2	Trinidad	20
Costa Rica	1	New Zealand	5	Turkey	1
Cuba	8	Nicaragua	2	Uruguay	1
Dominican Republic	4	Nova Scotia	1	Venezuela	70

Total members in foreign countries 340

Grand total 4,109

TABLE IV

Comparison of Accrued Income by Calendar Years

	1941	*1942*	*1943*
Dues			
Members	$28,920.00	$30,270.00	$30,320.00
Associates	4,784.00	5,624.00	6,096.00
Total	$33,704.00	$35,894.00	$36,416.00
Bulletin			
Subscriptions	$ 4,650.15	$ 3,937.22	$ 4,125.10
Advertising	8,271.13	8,168.10	8,728.54
Total	$12,921.28	$12,105.32	$12,853.64
Back Numbers, etc.			
Bound Volumes of Bulletin	$ 2,288.00	$ 2,152.90	$ 2,859.20
Back Numbers of Bulletin	895.18	556.99	1,448.46
Other Publications	113.95	129.94	117.16
Total	$ 3,297.13	$ 2,839.83	$ 4,424.82
Special Publications			
Geology of Natural Gas*	$ 336.54	$ 372.60	$ 592.62
Geology of Tampico Region*	173.30	146.35	257.10
Index	15.20	—	—
Gulf Coast*	327.20	245.60	343.63
Struct. Evol. of Sou. California*	1.60	—	—
Map of Sou. California*	22.31	21.85	30.85
Miocene Stratigraphy of California*	220.00	138.10	206.50
Recent Marine Sediments	710.00	105.10	63.00
Stratigraphic Type Oil Fields*	1,612.41	3,504.93	1,296.01
Source Beds of Petroleum*	779.80	1,746.65	692.97
Possible Future Oil Provinces	1,165.66	571.23	328.24
Origin of Oil	309.00	312.00	120.90
Permian of W. Tex. & S.E. N. Mex.	—	257.45	445.70
Petroleum Discovery Methods	—	573.00	340.00
Sedimentation	—	240.00	293.50
Total	$ 5,673.02	$ 8,234.86	$ 5,011.02
Other Income			
Convention Receipts (Net)	$ 632.84	$ —	$ —
Delinquent Dues Charged Off	333.35	378.00	360.00
Interest, General Fund	2,052.97	2,015.16	1,793.68
Interest, Research Fund	78.27	74.06	60.15
Interest, Publication Fund	509.90	546.06	518.72
Profit, sale of Investments, Gen. Fund	450.00	60.41	—
Miscellaneous	136.28	85.83	155.88
Sale of Library	6.00	17.50	17.50
Members Reinstated	97.50	32.50	49.75
Adjustment of stated value of Investments to lower of Cost or Market	—	2,951.55	2,760.39
Regional Cross-Sections	123.52	27.10	43.45
Inventory Increase	—	6,227.93	—
Donations, Powers Medal Fund	—	—	5,296.50
Total	$60,016.06	$71,490.11	$69,761.50

* Income of Publication Fund.

TABLE V

COMPARISON OF ACCRUED EXPENSES BY YEARS

General and Administrative Expenses	*1941*	*1942*	*1943*
Salaries—Manager	$ 3,750.00	$ 3,750.00	$ 4,250.00
Clerical	5,770.13	5,104.80	5,353.45
Payroll taxes (including Penalty & Int)	—	4,484.87	422.10
Rent	1,600.00	1,620.00	1,674.00
Telephone and Telegraph	349.61	367.27	304.09
Postage	2,116.43	1,812.98	2,043.95
Office Supplies and Expenses	467.70	394.16	564.22
Printing and Stationery	193.49	405.64	673.04
Audit Expense	300.00	300.00	300.00
Insurance and Taxes	210.14	237.11	239.29
Convention Expense (Net)	—	677.25	350.41
Freight and Express	219.68	229.38	270.39
Bad Debts	776.82	922.50	1,002.23
Miscellaneous	231.50	296.46	227.08
Depreciation—Furn. and Fixtures	75.75	53.35	111.33
Investment Counsel	400.00	400.00	400.00
Traveling Expenses	180.40	140.09	205.74
Excess of Cost of Investments over lower of Cost or Market	2,352.66	—	—
Geologic Map of North America[1]	1,000.00	—	—
Bass-Neumann Oil Analysis[1]	1,025.13	—	—
Van Tuyl-Parker[1]	78.67	—	—
Tectonic Map of United States[1]	75.29	188.71	975.75
Waldschmidt's Core Analysis[1]	31.35	—	—
Revelle-Shepard Oceanography[1]	16.22	—	—
Donation—Soc. of Econ. Paleon. and Min.	1,100.00	—	1,500.00
Expense—Dist. Lecture Com.	—	500.00	500.00
Expense—Natl. Service Com.	—	652.26	364.62
Expense—Amer. Geol. Assoc.	—	—	327.50
Total	$22,320.97	$22,536.83	$22,059.19
Publication Expenses			
Salaries—Manager	$ 3,750.00	$ 3,750.00	$ 3,750.00
Editorial	3,960.00	4,013.23	3,980.50
Printing Bulletin	18,668.26	17,753.64	16,328.20
Engravings	3,040.69	2,800.37	1,932.69
Separates	176.07	455.91	161.88
Stencils and Mailing	227.20	252.81	350.67
Binding Bulletins	599.40	578.62	623.05
Postage and Express (Bulletins)	1,216.54	977.98	765.36
Copyright Fees	24.00	24.00	24.00
Freight, Express, Postage (Other Publ.)	49.81	188.71	92.82
Discounts	22.90	3.11	—
Miscellaneous	100.99	59.75	50.38
Special Publications	1,197.77	12,597.15	637.76
Bulletin Inventory Decrease	290.20	—	—
Special Publication Inventory Decrease	1,119.02	—	5,546.08
Regional Cross-Sections	85.33	15.73	44.53
Total	$34,528.18	$43,471.01	$34,287.92
Total Expense	$56,849.15	$66,007.84	$56,347.11

[1] Research Fund Project.

TABLE VI

COMPARISON OF NET INCOME BY YEARS

	1941	1942	1943
Accrued Income	$60,016.06	$71,490.11	$69,761.50
Expenses			
General and Administrative	22,320.97	22,536.83	22,059.19
Publication	34,528.18	43,471.01	34,287.92
Total	$56,849.15	$66,007.84	$56,347.11
Excess Income over Expenses	3,166.91	5,482.27	13,414.39

TABLE VII

INVESTMENTS

	Cost	Market Value End of Year
1941 Values		
General Fund	$65,266.95	$57,198.83
Publication Fund	16,569.33	14,698.65
Research Fund	2,411.77	2,264.27
Total	$84,248.05	$74,161.75
1942 Values		
General Fund	$62,272.48	$56,717.53
Publication Fund	16,671.45	15,194.18
Research Fund	2,485.70	2,335.70
Total	$81,429.63	$74,247.41
1943 Values		
General Fund	$63,625.03	$60,282.23
Publication Fund	16,622.40	15,544.62
Research Fund	2,545.85	2,544.60
Total	$82,793.28	$78,371.45

TABLE VIII

COMPARISON OF COST OF BULLETIN

	1941	1942	1943
Total Expenses	$31,763.11	$30,651.31	$27,958.93
Monthly Edition	4,700	5,000	5,000
Total Copies Printed	56,400	60,000	60,000
Total Pages Printed, Including Covers	2,702	2,315	2,118
Total Pages of Text	2,273	1,893	1,674
Total Cost Per Copy	$ 0.563	$ 0.511	$ 0.465

TABLE IX
(Section 1)
SPECIAL PUBLICATIONS

	Geology Natural Gas (1935)	*Geology Tampico Region (1936)*	*Gulf Coast Oil Fields (1936)*	*California Map (1936)*	*Total*
Inventory					
Dec. 31, 1942	$1,472.00	$1,493.08	$ 693.23	$ 38.40	$3,696.71
Dec. 31, 1943	1,080.00	1,288.27	568.62	34.72	2,971.61
Sales	592.62	257.10	343.63	30.85	1,224.20
Total Edition	2,500	1,575	2,510	940	
Copies on Hand					
Dec. 31, 1942	368	652	395	480	
Dec. 31, 1943	270	563	324	434	
Number of Pages	1,227	280	1,070	—	
Cost (inventory) Per Copy	$ 4.00	$ 2.29	$ 1.755	$ 0.08	
Selling Price					
Members and Associates	4.50	3.50	3.00	0.50	
Non-Members	6.00	4.50	4.00	0.50	

TABLE IX
(Section 2)
SPECIAL PUBLICATIONS

	Miocene Stratigraphy of California (1938)	*Recent Marine Sediments (1939)*	*Stratigraphic Type Oil Fields (1942)*	*Source Beds of Petroleum (1942)*	*Total*
Inventory					
Dec. 31, 1942	$1,955.25	$ 109.20	$3,840.74	$1,925.70	$7,830.39
Dec. 31, 1943	1,898.32	75.60	3,245.30	1,467.55	6,686.77
Sales	206.50	63.00	1,296.01	692.97	2,258.48
Total Edition	1,530	1,500	2,526	1,539	
Copies on Hand					
Dec. 31, 1942	790	39	1,361	786	
Dec. 31, 1943	767	27	1,150	599	
Number of Pages	450	736	902	566	
Cost (inventory) Per Copy	$ 2.475	$ 2.80	$ 2.822	$ 2.45	
Selling Price					
Members and Associates	4.50	4.00	4.50	3.50	
Non-Members	5.00	5.00	5.50	4.50	

TABLE IX
(Section 3)
SPECIAL PUBLICATIONS

	Origin of Oil (1941)	*Petroleum Discovery Methods (1942)*	*Sedimentation (1942)*	*W. Texas N. Mexico Symposium (1942)*	*Possible Future Oil Provinces (1941)*	*Total*
Inventory						
Dec. 31, 1942	$ 24.25	$ 507.38	$ 136.59	$ 271.27	$ 111.63	$1,051.12
Dec. 31, 1943	70.69	290.93	32.34	131.07	1.21	526.24
Sales	120.90	340.00	293.50	445.70	328.24	1,528.34
Total Edition	905*	1,500	1,208**	521	2,052	
Copies on Hand						
Dec. 31, 1942	47	729	435	356	277	
Dec. 31, 1943	137	418	103	172	3	
Number of Pages	81	164	68	231	154	
Cost (inventory) Per Copy	$ 0.516	$ 0.696	$ 0.314	$ 0.762	$ 0.403	
Selling Price						
Members and Associates	1.00	1.00	0.50	1.50	1.00	
Non-Members	1.00	1.00	0.50	2.00	1.50	

* Two hundred and five copies printed in third edition, 1943.

** Two hundred and eight copies printed in second edition, 1943.

TABLE X

BUDGET

	1943	1944 Estimate
REVENUE		
Dues		
Members	$30,320	$30,000
Associates	6,096	6,000
Reinstatements and Delinquents	410	400
	$36,826	$36,400
Bulletin		
Subscriptions	4,125	4,000
Advertising	8,728	8,000
Bound Volumes	2,859	2,000
Back Numbers	1,448	750
	$17,160	$14,750
Special Publications		
Geology of Natural Gas	592	500
Geology of Tampico Region, Mexico	257	250
Gulf Coast Oil Fields	343	300
Tectonic Map of California	30	25
Miocene Stratigraphy of California	206	150
Recent Marine Sediments	63	—
West Texas Regional Sections	43	25
Stratigraphic Type Oil Fields	1,296	1,000
Source Beds of Petroleum	692	500
Possible Future Oil Provinces	328	—
Origin of Oil	120	100
Oil-Discovery Methods	340	300
Permian of West Texas and Southeastern New Mex.	445	250
Tectonic Map of United States	—	1,500
Sedimentation	293	50
	$ 5,048	$ 4,950
Other Income		
Investments	2,732	2,500
Convention (Net)	—	—
Miscellaneous	289	250
	$ 3,021	$ 2,750
TOTAL REVENUE	$62,055	$58,850

	1943	1944 Estimate
EXPENSE		
General and Administrative		
Salaries	$ 9,603	$ 9,600
Rent	1,674	1,600
Telephone and Telegraph; Postage	2,348	2,350
Audit Expense	300	300
Investment Counsel	400	400
Insurance, Taxes	660	675
Bad Debts	1,002	1,000
Convention (Net)	350	500
Office Supplies, Miscellaneous	1,940	1,950
	$18,277	$18,375

Bulletin Publication		
Salaries	7,730	7,750
Printing	16,328	18,000
Engraving	1,932	2,000
Separates	162	300
Cloth Binding	623	650
Postage and Express	765	900
Miscellaneous	528	600
	$28,068	$30,200
Special Publications		
Sedimentation	149	—
Origin of Oil	178	—
West Texas Regional Sections	45	25
Tectonic Map of United States	975	5,500
Tampico Region, Mexico	160	—
Source Beds of Petroleum	150	—
Permian Symposium	—	500
Freight, Express, Postage	93	75
	$ 1,750	$ 6,100
TOTAL EXPENSE	$48,095	$54,675

EXHIBIT III. REPORT OF EDITOR

Possibly the shortest intelligible editor's report would require only five words, namely, "The *Bulletin* speaks for itself." On the other hand a fully detailed editorial résumé conceivably could, with little padding, consume more than our entire monthly allotment of pages. You doubtless will be pleased to learn that your editor favors the former type. Nevertheless, it seems necessary briefly to explain some features of the impact of the war upon our editorial policies and procedures, even though we well remember Pope's sage warning that you can "explain a thing 'till all men doubt it."

We could not conceal from the membership, even if we so desired, the patent facts that the contents of the *Bulletin* have been diminished, and that the quality of the paper has decreased. Note well, however, that we said "paper," not "papers," for there is reason to believe that the high quality of the contributions of other years has been maintained in the articles which appeared in Volume twenty-seven. It has not been possible, however, to achieve quite the same balance in subjects presented as was customary in pre-war days.

With prices of every commodity skyrocketing, the membership will perhaps be pleased to note that the total cost of the *Bulletin* in 1943 was $27,960, or nearly $4,000 less than the all-time high of 1941 when 300 less copies per month were printed than our present total issue of 5,000. Moreover, the average cost of each *Bulletin* in 1943 fell to 46.5 cents as compared with a high of 56.3 cents in 1941, and an average cost of approximately 52.5 for the previous five-year period. The total number of printed pages in 1943, however, fell to 2,118, a marked reduction from the all-time high of 2,702 pages in 1941. Inasmuch, however, as the total number of words per page of the *Bulletin* is now nearly 20 per cent greater than prior to the July, 1942, issue, the total actual reduction in annual content is not as great as the figures at first suggest. The comparative data which provide the basis for these statements are given in greater detail in Table I.

Although editorial staff and contributors alike have been, and will continue to be, operating under various rather severe war-time restrictions, it not only appears that we have been able to present at least an adequate variety and volume of scientific papers in 1943, but also that we will be able to increase the total number of pages in 1944. Moreover, the editor's perennial fear that there will be a dearth of suitable manuscripts sub-

TABLE I

SIZE AND COST OF BULLETIN

Year	*Monthly Issue*	*Total Annual Pages*	*Total Expenses*	*Cost per Bulletin*
1937	3,500	2,061	$21,600	$0.515
1938	3,900	2,174	23,930	0.512
1939	4,400	2,374	26,650	0.505
1940	4,700	2,624	30,150	0.535
1941	4,700	2,702	31,760	0.563
1942	5,000	2,315	30,650	0.511
1943	5,000	2,118	27,960	0.465

mitted has never been fully realized. During 1943, a total of 74 articles were printed, 54 of the contributions being "major papers," and 20 falling into the category of "geological notes." Although this represents a marked reduction from the 1941 figures, it is a slight improvement over our 1942 record. The new editor will take office with a comfortable, but far from overwhelming, backlog of outstanding papers awaiting publication.

Table II shows that the sources of *Bulletin* contributions have not materially changed during the past seven years, although the number of papers written by consulting geologists seems gradually to be diminishing, and members of university departments of geology, or of the Federal or State geological surveys, are apparently contributing somewhat more heavily than in the past.

TABLE II

SOURCES OF BULLETIN PAPERS

Year	*Total Papers*	*Convention Papers*	*Non-Convention Papers*	*Oil-Company Authors*	*Consulting Authors*	*Others**
1937	83	34	39	45	14	25
1938	92	49	27	41	16	34
1939	108	48	28	53	15	40
1940	112	44	35	53	22	37
1941	119	56	44	47	19	53
1942	72	30	42	28	13	31
1943	74	34	40	30	8	36

* University, Federal, and State geological survey sources, in 1943, divided as follows: Universities—18, Federal survey—9, State surveys—9.

Inasmuch as uncertainties surrounding my war-time plans have made, and will continue to make, me a most unreliable editor, I have, with some reluctance, felt it necessary, for the good of the Association, to insist on withdrawing my name from possible consideration after a one-year term. Perhaps, therefore, you will pardon me if I transgress the usual proprieties and make several suggestions which the new incumbent might hesitate to advance—and which he, or you, may, for that matter, feel free to repudiate.

Our general editorial routine is indeed well systemized. The associate editors, many of whom deserve glowing individual citations, the committee for publication under the able chairmanship of J. V. Howell, and the indefatigable J. P. D. Hull, together with his editorial staff, do all the work and deserve all of the credit. As a result of their labors it may be said that few if any scientific journals give more careful pre-publication scrutiny to their printed matter. Nevertheless, we should, perhaps, provide a little greater guarantee of continuity of *editorial policy*, while at the same time provisions are being made for a fairly rapid turn-over of editors in order to insure a relatively constant flow of fresh viewpoints. At any rate, careful consideration should be given to the wisdom of electing the editor for a two-year, rather than a one-year term, and he should, I believe, be eligible for a second term only.

In March, 1937, the Association published its *Comprehensive Index, 1917–1936*. By March, 1947, the Association should have issued a comprehensive index for the years 1917–1946. For this date it is, to use the old cliché, already "later than you think." For such an index is not just something that can be whipped into shape by our present staff in its odd hours, if any. Particularly is this true because the volume of printed material issued during our third decade will not fall far short of equalling the editorial production of our first score of years. I suggest, therefore, that the index problem, which I should have at least partially solved, but did not, receive early and careful consideration.

Finally, it may be suggested that the world's largest geological society might logically aspire to sponsor the world's most influential geological journal. If we have not already reached that goal we have at least made large strides in the right direction. But, because the *Bulletin* has now become essentially stabilized, if not stagnant, in style and format, perhaps even more rapid progress might be made were we to have the advantage of the consensus of all our members, and, possibly, particularly of our younger men, regarding what the *Bulletin* should, or should not, be and do. This composite opinion should, I believe, be obtained through a carefully prepared questionnaire on all phases of our editorial work, and all aspects of our publications. Were such a questionnaire to be circulated in the first post-war year we would no doubt accumulate much pertinent information for the guidance of future editors and executive committees. I have the belief that, in connection with the growing publications problem, the wisdom of the members, in addition to that of the officers, should be tapped in order that this Association, and its editorial products, should continue to grow in greatness.

CAREY CRONEIS, *editor*

EXHIBIT IV. REPORT OF RESOLUTIONS COMMITTEE

On the occasion of the twenty-ninth annual meeting of the American Association of Petroleum Geologists, in behalf of that Association and the associated Society of Economic Paleontologists and Mineralogists and the Society of Exploration Geophysicists, *be it resolved* that we express our sincere appreciation of the following organizations and individuals for their whole-hearted coöperation and untiring efforts which have resulted in the success of this, our second, war-time conference.

1. Our host, the Dallas Petroleum Geologists, its officers, convention committees and members, for their gracious hospitality.

2. The management and convention staff of the Baker Hotel, meeting headquarters, and the coöperating hotels of Dallas, for their capable housing of our membership during present war-time conditions.

3. The geological societies, State geological surveys, the United States Geological Survey and the Geological Society of America, for their instructive and educational exhibits.

4. The Petroleos Mexicanos and the Institute of Geology, of Mexico City, for their participation in the meeting and for their excellent display of geologic maps and Recent volcanic rock specimens.

5. The officers and various committees of the Society of Economic Paleontologists and Mineralogists and the Society of Exploration Geophysicists for their joint efforts contributing to the success of the meeting.

6. The publications committee of the Dallas Petroleum Geologists, under the chairmanship of S. M. Aronson, for the compilation and publication of the *Dallas Digest*, an innovation which most completely presents the subject matter of the technical program and is especially appreciated by all in attendance.

And, *be it further resolved*, that we express our appreciation to, and commend the works of, the following.

1. The business manager and headquarters staff for their continued, capable management of Association affairs during the past year.

2. The national service committee for its timely and persistent effort directed toward the coördinating of petroleum geology with the successful prosecution of the war.

3. The numerous members of the Association and its associated societies, who, in their civilian capacities, are unstintingly contributing time, thought, and energy to the solution of petroleum-industry problems that are of vital concern to our democratic way of life.

In conclusion, we express our pride in, and our admiration for, our fellow members and associates who are now serving in the armed forces of the United Nations. We regret their absence from this meeting and extend to them our wishes for a speedy, victorious return to their wonted pursuits of peace. CLARENCE L. MOODY, *chairman*

EXHIBIT V. RECOMMENDATIONS ADOPTED BY BUSINESS COMMITTEE

The business committee recommends to the annual business meeting that these proposals be adopted.

1. The executive committee recommends and the business committee has approved the following changes in the constitution.

ARTICLE I. Name. Delete the words—"the 21st day of April, 1924, for a period of twenty (20) years."

ARTICLE II. Object. Delete the words—"To maintain a high standard of professional conduct on the part of its members; and to protect the public from the work of inadequately trained and unscrupulous persons posing as petroleum geologists."

2. The executive committee recommends and the business committee has approved the following changes in the by-laws.

ARTICLE I, Sec. 2. That the fourth sentence be amended so as to read—"A bill shall be mailed to each member and associate before December first of each year . . . *et cetera*."

That the fifth sentence be amended so as to read—"Members or associates who shall fail to pay their annual dues by January first shall not receive copies of the January *Bulletin* or . . . *et cetera*."

3. The executive committee recommends and the business committee has approved the following proposal.

That the Maracaibo Regional Section of the American Association of Petroleum Geologists be dissolved and its charter revoked.

4. The business committee also recommends that the executive committee appoint a special committee to formulate a revised code of ethics to be submitted to the Association for adoption at the next annual meeting, and that a copy of the new proposed code be placed before the membership-at-large through the medium of the *Bulletin* at least 60 days prior to the next annual meeting.

5. The business committee recommends that the executive committee appoint a special committee to study, prepare, and present a method of election of officers by mail ballot, together with the necessary changes in the constitution and by-laws and providing machinery for the counting of ballots. The method of election so formulated is to be presented for consideration at the business committee meeting in 1945. Said special committee shall file their report with the executive committee by December 1, 1944, and the executive committee shall send a copy of such report to all district representatives of the A.A.P.G. and to the presidents of the affiliated local societies by January 1, 1945.

6. The business committee recommends that the reports of the standing and special committees which were read and approved in the business committee meeting be approved and published in the *Bulletin*.

ORVAL L. BRACE, *chairman* ROBERT E. RETTGER, *secretary*

Exhibit VI. Report of National Service Committee

The national service committee was established in April, 1941—eight months before our country entered the war. Its functions were (1) to recommend plans to the executive committee which would enable the Association to render effective service to the nation during the existing emergency and (2) to coöperate with the National Roster of Scientific and Specialized Personnel by recommending the men best fitted to fill such emergency positions as might become necessary.

Under the chairmanship of Fritz L. Aurin, the committee discharged these obligations and went far beyond them. It took its mandate from geological tradition, and if it felt that work it could do, or information it could supply, would add even slightly to the effectiveness of the total war effort, the work was done and the information was supplied.

The National Roster, which was bewildered and inadequately staffed during the early months of the war, seemed somewhat indifferent to the committee's remarkable compilation of information on geologists, men with scientific training, successful in meeting difficulties and emergencies, familiar with a variety of countries, languages, and training—men who comprise a large percentage of the American travelers who also are trained observers. The committee therefore brought this information to the attention of various military agencies and also of civilian agencies in our Government. It created opportunities to discuss with men in high official positions, the place of geologists in the war effort. It strove continuously for the effective use of all sciences, and particularly of geological science, in the war effort.

At the same time the committee steadfastly opposed the wasteful use of geologists. Its position has been that effective use of our resources is more important than sentiment and enthusiasm. There will, of course, be brilliant exceptions, but as a rule, a geologist working to make available the mineral resources with which to win the war will be of greater service to his country than a geologist in uniform, unless the uniformed geologist is on an assignment where his science can effectively be applied.

During the past year the committee has followed the pattern earlier established. It has assumed it should work on any activity through which geology or geologists, and in particular the American Association of Petroleum Geologists, might shorten the war. This has had the approval of the executive committee, and that committee, through our president, has been informed of each activity of the national service committee.

The committee has coöperated freely and completely with military units, scientific societies, government agencies, and with individual civilians. It has worked openly and aboveboard for those things which it felt were in the national interest. Its information, which might in any conceivable way contribute to the war effort, has been given to any organization and individual who might, through its possession, help our country. It has not been concerned with who received "credit" for information, ideas or achievements. It has been greatly concerned when achievement was lacking.

As a supplement to the original roster, information was gathered concerning the present status of our members in the armed forces—rank, military unit and last position as indicated by postoffice addresses. In addition to the list in the hands of the district representative of the committee, a master list has been established at Association headquarters in Tulsa where, so far as possible, information is kept current. The primary purpose was to make sure that information would be promptly available for any branch of the military service that wanted to locate a geologist in its own branch without delay and to be able to furnish information concerning the training, experience and other qualifications of any such geologist. The list serves an important secondary purpose, since, through it, our members can learn how they may reach their friends in the service and send them the letters that mean so much. This list was published in the December, 1943, number of the *Bulletin*, but the master list is revised as new information comes to hand.

In addition to information concerning our own members, the committee obtained lists of geology graduates now in the armed services from selected schools. No effort was made to completely cover this field, but information was secured concerning more than 200 geology graduates who are not members of the A.A.P.G. This was done because it was realized that, in the event need for a geologist or geologists, arose in some particular area, members of the A.A.P.G. might not be available. It was felt that if the committee knew of at least 1,000 geologists in uniform the chances that it would be able to supply information concerning men who would be available for any assignment in any locality would be improved. Incidentally, this information concerning geology graduates, was furnished by the committee to the Geological Society of America. It is felt that a complete directory of the geologically trained men in this country should be maintained at some central point and at the present time the G.S.A. appears to be an appropriate agency to establish, compile and maintain such a list. The committee, through its chairman, has urged this activity by the Geological Society of America, has advised of its readiness to coöperate, and has furnished material suitable for incorporation in such a directory.

The committee has also recommended, through its chairman, that the American Association of Petroleum Geologists maintain, for ready reference, much more complete and up-to-the-minute information concerning the location, experience, and changes in status of its members than now is available, with all vital information on a single record that shall, so far as possible, be kept current. Decision must be made by the executive committee of the Association.

The desirability of maintaining a full-time representative in Washington for the duration of the war was recognized in 1942. The matter was discussed with the committee on war effort of the Geological Society of America and it was agreed that if a suitable representative could be found and if the project could be financed, a man to represent the two organizations would be maintained in Washington. The Geological Society of America was receptive to the idea and it appropriated $5,000 to be used in maintaining such a representative in 1942 and 1943. To date no geologist who, in the opinion of the two organizations, would be an effective representative and who could afford to undertake the assignment under this limited appropriation has been found, and the appropriation has not been used.

Such a representative would supplement, but in no way substitute for, the activities of and the help rendered by W. B. Heroy of our committee, and by W. W. Rubey, chairman of the Division of Geology and Geography of the National Research Council, and Homer L. Dodge, director of the Office of Scientific Personnel of the National Research Council. Many individuals in Washington have helped the committee through information and suggestions, but the men mentioned have been extraordinarily helpful. For example, it was primarily through the efforts of these men that a limited number of students of geology and geophysics in the undergraduate body of our colleges and universities may be deferred while they are pursuing their studies. Both the national service committee of our Association and the committee on war effort of the Geological Society of America were interested, but these men recognized an emergency and took needful action. The committees would have been too late.

Effort has been continued to secure recognition of the need for military geologists in the Corps of Engineers. Some success has attended this effort primarily due to the initiative and persistence of Major Raymond C. Moore who was, for a period, attached to the Corps of Engineers in Washington. Any contribution the committee may have made to this success was incidental and minor.

In coöperation with the committee on war effort of the Geological Society of America the national service committee established a contact with the Office of the Adjutant General. We learned that the adjutant general's office has received a number of requests for

officers with geological training and we now have arranged to supply that office with detailed information, taken in great part from the roster compiled by this committee, so that requests for men with geological training may be filled with well qualified and experienced men.

The committee has worked without interruption and also, unfortunately, without great success, in the interest of the departments of geology and of petroleum engineering in our colleges and universities. It has been recognized that under existing conditions there may be an hiatus of about four years following the war during which almost no men with adequate training in geology or petroleum engineering will be graduated from our schools. We have felt that the representations by educators and those made by individual geologists would probably carry little weight as long as the industry itself manifested no concern. We therefore attempted to interest the P. I. W. C. in registering a complaint and in continuing to press the importance of an adequate training program for the industry. Thus far this effort by the committee has had no success although some individual members of the P. I. W. C. recognize the importance of a training program.

Geology and geophysics were included in the list of "rare" occupations. This resulted largely through the individual effort of W. B. Heroy and Rodger Denison of this committee. For a period this greatly simplified deferment of geologists of draft age who were needed in industry.

There have been a multitude of minor activities, no one of them important in itself, but in the aggregate representing an appreciable amount of the service which this committee was established to render. The cases of many individuals, both in the Army and of draftees, have received attention with favorable outcome. Like seeds that have been planted, many of these activities may not mature for a substantial period. For example, about nine months ago, the committee was requested to supply the names of a number of men in the Armed Forces who could qualify as cartographers or expert draftsmen. The committee promptly provided the names of about 20 such men. Recently a request from another Army unit for men with cartographic training was received and the information was supplied over night.

During the year, members of the committee, and in particular Rodger Denison, Fritz L. Aurin, M. G. Gulley, and the chairman, have visited Washington many times either to discuss specific items or to secure information that might be important to the committee, to the Association, and to geology.

In addition, individual members of the committee have maintained a heavy correspondence both with geologists in the Armed Services and in the attempt to interest officers in responsible positions in the use of geology. For example, as soon as it was learned that the Ledo Road in Burma was under construction, letters were sent to the engineering officer in charge urging that geologists should be attached to the project and supplying names of geologists in the Armed Services who were well thought of to advise on the construction and maintenance of a road in jungle and mountainous terrane.

At present there is no yardstick with which effectiveness of the work of this committee during the past year may be measured. Its only claim is that it has tried to live up to its name.

I recommend that the national service committee be continued for another year.

I recommend the appointment of a committee to study and recommend some method, or methods, whereby the personnel information concerning our membership may be kept current.

By way of explanation one suggestion has been that it might be possible to devise a simple form to be printed on the reverse side of our annual dues notices which would list those changes in status which are most subject to change from time to time, and that the member could be urged to indicate on this form any changes in his personal status which

had taken place during the preceding year. It may be that some other method of eliciting this information would be more desirable or more practical.

It has been further suggested that if the suggestion made above were used, the dues notices, after they have served their purpose in the bookkeeping department, could then be used as a current card file on the membership. These cards, of course, would not contain items of information concerning the members which have not changed, nor will likely change from the original listing on the individual's application for membership.

K. C. HEALD, *chairman*

EXHIBIT VII. REPORT OF COMMITTEE FOR PUBLICATION

The committee met at 9:30 A.M., Tuesday, March 21, with ten members present.

In accordance with a request from president Denison, dated May 29, 1943, this committee undertook the solicitation of development papers to be presented by title at the Dallas meeting, and to be published in the annual review number. Sixteen papers have been arranged, to include the active areas of the United States, Canada, and Mexico, the latter countries being added this year.

Believing that every effort should be made to conserve the time of the authors, and to obtain a greater amount of uniformity in these papers, the committee prepared and sent to each author, an outline to be followed if desired, and a number of suggestions as to phases of development to be emphasized, and will revise and correct this outline for further use if the papers resulting show that it has become useful. Especial emphasis has been requested on methods of exploration, and geological reasoning leading up to each discovery.

The value of having these papers arranged by a standing committee appeared so apparent that at the request of the executive committee the arrangements for the 1944 papers are now being made by the various members of the committee for publications, and through their work much of the work has been accomplished during the Dallas meeting. Thus the authors will be selected, and enabled to commence the assembly of material, many months earlier than usual and the last-minute rush avoided.

The committee is unanimous in its opinion that greater emphasis be placed on recording in these annual papers the "case histories" of discoveries, and also the changing usages regarding formational names, geological "tops," or sand designations.

The chairman wishes here to express his appreciation of the excellent coöperation and assistance of the members of the committee, without which the assembling of the development papers would have been a difficult matter.

J. V. HOWELL, *chairman*

EXHIBIT VIII. ANNUAL REPORT OF GEOLOGIC NAMES AND CORRELATIONS COMMITTEE

The geologic names and correlations committee can report some good progress during the past year although the work has been restricted because some committee members could spare little time from their regular duties, and travel has been so limited that few of them could get together to discuss committee matters. The committee members are scattered through the many regions in which petroleum geologists work, and individually advise regarding matters of nomenclature, but in recent years most of the work has been done by three sub-committees, which were formed to study the Carboniferous, the post-Cretaceous, and Mesozoic.

The Carboniferous committee is now working on its final report. A preliminary draft was mailed in October, 1943, to the members of the committee and to many specialists through the United States. Although there is fairly good agreement in usage regarding the classification of the Mississippian rocks, there still appears to be no well defined stand-

ard usage for the Pennsylvanian, either in the Appalachian area or in the Mid-Continent area. Although agreement has not yet been reached, there has been a very worthwhile argument over the best usage, and good progress has been made. It is hoped that a satisfactory reconciliation of conflicting views may yet be achieved and a final report issued during the spring of 1944.

The Post-Cretaceous committee has not been on its task so long, but is also getting results. It has worked to stimulate and coördinate stratigraphic correlations in the Gulf Coast Tertiary of the United States. Its immediate objective is a Gulf Coast correlation chart for Texas, Louisiana, Mississippi, Alabama, and Florida, and it is hoped that it can be completed sometime in 1945. Two columns for Texas are already finished, having been prepared by the Houston and San Antonio geologists, who have held many conferences to reconcile differences. A preliminary chart has been prepared for northern Louisiana, but the one for southern Louisiana is not yet completed and discussions will have to be held between the geologists of the two sections in Louisiana. Geologists in Mississippi had prepared cross sections and had the matter fairly well in hand before the sub-committee was formed. The sub-committee appointed a Florida local committee to further the work in that area, with Mr. Barker as chairman, and they report favorable progress. One of the biggest problems of the Post-Cretaceous committee is the correct nomenclature and description of downdip formations that either do not appear on the surface or are of different facies. They also have a difficult problem to place the boundary between the Oligocene and Miocene.

The Mesozoic committee is the newest one and is getting its work planned. It has outlined the problems to be handled and made suggestions regarding the work necessary to solve them. It proposes that a standard section or standard sections be set up in the Mesozoic rocks for reference; it makes a positive statement that new stratigraphic names should be introduced only when they are based on work over large enough areas so that the need for such new names is evident. One of the difficulties of nomenclature is the large number of geologic names that are introduced as a result of very local work and commonly by young and relatively inexperienced geologists. Among the problems are the correlation of the groups of the Gulf and Comanche series of the Cretaceous from Texas to Florida; the character of the Cretaceous boundary in the subsurface of the Gulf Coast; and the relationships of the Eagle Mills-Smackover-Buckner sequence. In the Pacific Coast area the committee is studying the age and correlations of the Cretaceous and the character of the Cretaceous-Tertiary boundary. In the Rocky Mountains, among other problems, it lists the facies changes in the marine Jurassic, the regional stratigraphic and lithlogic features of the Kootanai, and a study of the Upper Cretaceous sandstone and shale tongues.

As long as geologic work is being done on surface beds and on subsurface formations, there will be the necessity of studying geologic names and correlations, and the work will never be completed, but always can be improved. The committee on geologic names and correlations will continue its work and make as much progress as possible under present conditions.

JOHN G. BARTRAM, *chairman*

EXHIBIT IX. REPORT OF COMMITTEE ON APPLICATIONS OF GEOLOGY

The committee on applications of geology has during the past year coöperated in the arrangement of programs of the Texas Academy of Sciences in Austin, in November, 1943, and has assisted in the preparation of papers before various local affiliated societies of the A.A.P.G. Members of this committee have also coöperated in extension courses given as a part of the Government program.

The opinion expressed in correspondence as to the form in which efforts of the committee, and of the Association, will be most effective is comprised in the following program.

1. An attempt should be made to start interest in geology by the public among students below the college grade.

2. Aid to members of the A.A.P.G. in the preparation of addresses to be given before other scientific societies and before non-technical groups, such as service clubs.

3. The editing of articles in the A.A.P.G. *Bulletin* to make them more useful to others than members.

1. K. K. Landes of the University of Michigan, has stated:

> While the popularization of geology among adults is desirable, it is also essential that we start lower in the age scale. Therefore, we are laying plans to send out a number of speakers after the war to address high school assemblies and high school teacher groups. . . . The subject of geology is taught in almost no high schools any longer, but where there is a high school teacher with whom geology is a hobby, he may inspire a group of students in the subject. . . . In an attempt to interest more high school teachers in the State in geology, we are planning after the war a summer session course in geology of Michigan. This will be mainly a travel course, with the students spending approximately two weeks on the campus and six weeks traveling over the State. Regardless of what subject they teach, after taking such a course they will talk a lot of Geology to their high school groups.

R. M. Barnes states:

> A good project that might be sponsored after the war by your Committee and a group from the Pacific Section is the teaching of more and better geology in our Western High Schools and Junior Colleges.

2. There has been only one formal request to the committee for assistance in the preparation of papers and this was for a talk before a Rotary Club. However, J. Brian Eby and I have aided in the preparation of material for extension courses and for general talks, and Dr. Eby has at five different times given a course in the interpretation of aerial photographs, extending over twelve weeks for each course. Dr. Eby suggests that the committee consider, as a part of this field endeavor, the preparation of scientific news broadcasts, but that instead of making the program of the type of those presented by the G.S.A. and of those presented by the University of California, the script be written for local stations on subjects of local geology, and that the script be presented with the idea that it would not be a part of a network presentation, but would be for a single station. The committee has not gone into this very cogent suggestion as to its practicability, but believes that a real search of these possibilities is desirable.

3. There are some articles in the A.A.P.G. *Bulletin* which without modification of the text, could be made appealing to others than members of the A.A.P.G. The annual review of developments in the different districts should have illustrations in the form of graphs, which will serve to orient the general reader, and as an experiment your chairman has consulted with the societies in the Gulf Coast area with the thought that the statistical part of the review could be shown in graphical form. The exhibit of the Houston Geological Society at this meeting is made up to show in two figures the overall picture of exploration and development in the Houston District for the year 1943. One of these illustrations shows the production and drilling picture by counties. A columnar section shows the distribution of wells drilled in the district by geologic objectives.

It is the thought of the committee that publications by A.A.P.G. members for State institutions and State geological surveys should use graphical methods of presentation to a larger extent. In this connection, the attention of the members should be called to some of the publications of the Department of Agriculture, and especially to *Miscellaneous Publication 504* by J. A. Bird, "Western Ground Waters and Food Production," issued in December, 1942. In this publication the diagrams show the mechanism of ground-water movement, and photographs show the use of ground water in agriculture. Furthermore, information concerning laws are presented in a single table whereby the pertinent information concerning the legislation of all the western states can be compared at a single glance.

It is your committee's thought that idealized diagrams, generalized charts, and other material summarizing the texts of geological articles should be used more widely, and particularly in reports which are being prepared for the information of the general public and which are designed to arouse their interest in the further investigation of geology. This is merely carrying a step forward the same idea which we have in our subsurface reports where we give electrical logs instead of the written description of formations, in order to simplify the correlation of wells.

The committee would emphasize the importance of the placing of geological talks on the program of service clubs, chamber of commerce meetings, and academies of science, and this can only be done by an effort of the individual members of the Association in their respective communities. It is not the thing which can be planned by this committee.

The committee further recommends that an effort be made to interest elementary and high-school science teachers in geology; and that the possibilities of local geologic talks over local radio stations be explored by individual members designated by the affiliated societies in the communities where there are radio stations.

PAUL WEAVER, *chairman*

Added to the chairman's report as a unanimously approved recommendation is the following motion by Geol. S. Buchanan: That the committee on applications of geology be authorized through its chairman to invite the various local affiliated societies to appoint local committees on applications of geology.

EXHIBIT X. REPORT OF MEDAL AWARD COMMITTEE

Following the approval at the annual meeting in Fort Worth on April 9, 1943, of the amendment to the by-laws which provided for a medal award committee, the committee was duly appointed. Acting under a prerogative provided by the constitution, I assumed the chairmanship of this committee. The rules and regulations to guide the committee's work were adopted by action of the executive committee on April 21, 1943.

The fund.—These rules gave power to the medal award committee to solicit funds in the sum of $10,000 for the "Sidney Powers Memorial Medal Fund." The first work of the committee and one which has engaged its attention throughout the year is this solicitation of funds. The first announcement and appeal for funds was sent out on June 15, 1943. Since that time the number and amount of contributions by months are as follows.

During Month	*Contributors*	*Amount*	*Total Cumulative*
June—1943	264	$1,736.50	$1,736.50
July	178	1,628.00	3,364.50
August	36	496.50	3,861.00
September	35	280.50	4,141.50
October	46	294.00	4,390.50
November	71	360.00	4,750.50
December	106	572.75	5,323.50
January—1944	41	354.00	5,677.25
February	19	100.00	5,777.25
Totals	795	$5,777.25	

Nearly 60 per cent of all contributions both in number and amount was obtained in the first 45 days after the solicitations were started. The fund has enjoyed a wide geographic appeal with 36 states and 13 foreign countries being represented among the contributors. The 795 contributors shown in the table are 19.3 per cent of the 4,109 members in good standing on March 1, 1944. Individual contributions have ranged from $1 to $100, there being 54 of the former and 13 of the latter. The average contribution to date has been $7.27.

The affiliated geological societies were of distinct service to the committee in connec-

tion with the medal fund. On the request of the chairman they all brought the fund to the attention of our members, and some organized a committee to personally solicit funds. The highest percentage of participation by members residing in any geographic unit was obtained by this method. The large increase in contributions shown in November and December is the direct result of work done by local affiliated societies.

After approval of the committee, the sum of \$5,000 from the funds collected was invested in Series G United States Government War Bonds. This series is bought at par and interest is paid annually at the rate of 2½ per cent.

The medal.—Authority was also granted the committee to adopt a design for the "Sidney Powers Memorial Medal" and to have dies executed from which to stamp the medal. A design was submitted to the committee and approved. A contract was entered into with the Medallic Art Company, 210 East 51st Street, New York, for execution of the design and cutting the dies, for the sum of \$675. Work has progressed so that in the near future the dies will be available for stamping a medal. The exact cost of a single medal in 14-carat gold can not be exactly determined until the dies have been cut, but will be somewhere between \$175 and \$225. There will be an additional charge of \$30 per medal for the replaceable name plate which allows the name of the recipient to be stamped on the medal, rather than being engraved after the medal is struck.

Work of committee.—In addition to the two items previously mentioned, the activity of the committee has included an extensive exchange of ideas with respect to methods of examining candidates for the award, and with organizing a symposium of ideas concerning what character of achievements can be regarded as worthy of a medal award. The first meeting of the committee, held on March 21, 1944, in connection with the annual Association meeting, was for the final disposition of these and other questions.

No candidate for the medal was officially considered by this committee since the fund was incomplete and had produced no income. With the investment of the funds here indicated in war bonds there will be in 1946 adequate funds for awarding a medal.

Since this is a standing committee, all records of correspondence and actions of this committee will be handed to the newly appointed chairman.

A. RODGER DENISON, *chairman*

EXHIBIT XI. REPORT OF DISTINGUISHED LECTURE COMMITTEE

During this second year of its activity, the distinguished lecture committee worked to organize its program more efficiently. It was the aim of the committee to improve its service to the affiliated societies: (1) by submitting its list of speakers for the season before the society meetings began; (2) by offering one speaker for each month from October to May inclusive; (3) by arranging each tour well in advance of its scheduled date; (4) by supplying abstracts or synopses of the lecture whenever possible.

The committee has been successful in securing ten outstanding scientists, qualified to speak on subjects of broad interest to geologists. In an effort to widen the scope of the lectures, the committee invited distinguished speakers from our neighbor nations of Mexico and Canada to discuss important and timely developments in their countries.

The affiliated societies have again responded enthusiastically to the program of the committee. Requests for speakers have been received in numbers commensurate with the financial ability of the societies to participate, and the societies have been supplied with the requested speaker in virtually all instances. Speakers have been brought to 23 affiliated societies and sections, and only two were unable to participate. By the close of the lecture season, approximately 110 lectures will have been delivered. The revolving fund of \$1,000, which the association has advanced to this committee for its operations, has been kept actively in motion, and every society has paid its obligations promptly so that the fund is still intact.

As a result of its activities this year, the committee feels that the program of the distinguished lecture committee should be continued and systematized so that the local geological societies will be kept abreast of the new thoughts and developments in geology It is the committee's hope that if the committee is continued it will be able to present a fairly complete list of speakers on a variety of subjects of broad interest well in advance of the opening of the 1944–45 season of technical meetings.

Finally, the committee wishes to thank again the distinguished scientists, who agreed to sacrifice their personal comfort in order to bring their contributions to the local groups. These men are:

W. Taylor Thom, Jr.	Princeton University
Claude E. ZoBell	Scripps Institution of Oceanography
Richard Joel Russell	Louisiana State University
Ezequiel Ordonez	Comision Impulsora y Coordinadora de la Investigacion Cientifica, Mexico
Fred M. Bullard	University of Texas
Sam H. Knight	University of Wyoming
George S. Hume	Oil Controller's Office, Canada
G. Marshall Kay	Columbia University
John Emery Adams	Standard Oil Company of Texas
Gayle Scott	Texas Christian University

JOHN L. FERGUSON, *chairman*

EXHIBIT XII. REPORT OF COMMITTEE ON COLLEGE CURRICULA IN PETROLEUM GEOLOGY

This is the fourth annual report of the committee on college curricula in petroleum geology.* The early concern of this committee, as its name implies, was with the needs in petroleum geology, but much of what was learned and compiled was applicable to geology in general. At any rate, the committee did not hesitate to broaden the scope of its investigation and of its recommendations beyond the field of petroleum geology.

Since this country entered the war there have been many changes in educational routines. Courses have been concentrated and the time of training in numerous subjects has been reduced. Some courses have been dropped and new ones have been added. Thus, the whole system which was at first under scrutiny by this committee has been modified, and as a consequence new questions have arisen for consideration. We have postponed further study of the normal curricula and have looked more particularly into problems relating to the acceleerated courses, the teaching of geology for military uses, and how these problems may affect post-war educational programs.

Our first approach to these war-time questions of education was outlined in our third report. Subsequent to the appearance of this report, further ideas were solicited from the several members of the committee. Their replies were summarized in the form of a letter questionnaire which was then mailed to the heads of the geological departments of 86 institutions widely scattered throughout the country. In this manner we attempted to get, not only the views of the committee but also the opinions of the men who are actually engaged in the problems of teaching geology at the present time. From these 86 institutions 31 answers were received, and in nearly all cases the comments were very much worth while.

It is our purpose in this year's report of the committee to summarize the significant material in these questionnaires and in the replies thereto. Accordingly, we are dividing the subject under the same six heads that were used in the correspondence.

* First report published in the *Bulletin*, Vol. 25 (1941), pp. 969–72.
Second report published in the *Bulletin*, Vol. 26 (1942), pp. 943–46.
Third report published in the *Bulletin*, Vol. 27 (1943), pp. 694–97.

1. *Accelerated program of instruction.*—In many institutions so-called accelerated programs of instruction in geology, as well as in other subjects, have been adopted as a war emergency measure. The question has been raised as to whether such accelerated courses should be continued after the war. We have the following from one of our members.

If by "accelerated program" we mean that the same length of time will be devoted to a course as formerly was devoted to it in the normal prewar program, then it might be quite desirable to continue such a program indefinitely, at least at some institutions. Accelerated programs, however, should be optional and the customary program of two semesters per year, or four quarters per year, should also be offered. Few students could stand the pace of three years of continuous accelerated program with no vacation. The accelerated programs now in force provide for practically no vacation for either student or instructor. If, on the other hand, by "accelerated program" we mean an abbreviated course in Geology, that is, a so-called "short course," then I am emphatically against it. The old saying that a little knowledge is a dangerous thing is especially true in Geology.

Most of the professors who commented on this paragraph were in entire agreement with it. They pointed out that three of the principal objections to these accelerated curricula in geology, where the work is practically all in the laboratory or classroom, are: (1) that the student does not receive the field experience which is so necessary in this science; (2) that the instructor has no opportunity for his own field investigations or other research; and (3) that there is little opportunity for the student to make enough money to meet his financial obligations. We quote from one correspondent:

I am strongly and unalterably opposed to the "accelerated program" for anything but a war emergency. To be sure it requires only simple arithmetic to demonstrate that in three years of instruction given continuously for twelve months in each year the same amount and the same content of courses can be covered that is ordinarily done in a four-year curriculum. But I deny that the man graduating from the three-year program is as well educated or as ready to take his place in professional work as the man graduated from the four-year program. I would maintain this point for any field of science or art, but I think it is particularly important for geologists to whom field experience is such a necessary and valuable asset. Quite apart from the experience of a summer camp or summer job which must be denied to the three-year man, there is the factor of maturity. Normally there would go with a Bachelor's degree a certain amount of maturity, and I am speaking now of the maturity that only time itself can develop. In this the three-year program must inevitably fall short. I am aware that it is possible to "pre-age" whiskies and by synthetic means to speed up the ripening of fruits and vegetables, but I have yet to hear of a successful process for pre-aging a youth.

2. *Princeton experiment.*—Princeton, in the summer of 1943, repeated its experiment of offering certain courses in geology open to High School pre-seniors. This "experiment" was briefly described in our third report.* It is a plan for giving selected High School pre-seniors a summer field course in geology, which is primarily intended to show them whether or not they may be interested in this science as a profession. It is not to be offered as a substitute for college training. In our questionnaire we asked, "What are your opinions concerning this method of accelerating the training in geology? Do you have any suggestions regarding duplication or expansion of the plan under the auspices of several institutions after the war is over?" To these questions we had numerous replies which indicated that the exact nature and object of the plan are not fully understood. However, because of the references to the important subject of teaching geology to High School students, we quote as follows.

(a) I do not favor this experiment as a means of "accelerating" the training of geologists, but I do think it is very desirable that high school students have an opportunity to at least learn that such a field as geology exists and possibly to get some real acquaintance with it before coming to college. Otherwise Geology departments must always suffer a certain handicap in competition with, for example, physics, chemistry and biology for the better students.

(b) An early interest in Geology as a science can be developed in secondary schools, but I am not strongly in favor, at this time, of offering University instruction to pre-University students.

(c) The Princeton Experiment is interesting, and there is no reason why high school students cannot get considerable geologic training in such a course if it is not made too technical. I believe

* See *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 27 (1943), p. 695.

the principles of any natural science can be started to good advantage in high school. Such courses, however, should not take the place of the fundamentals of mathematics, language, and history. There are too many high school students trying to follow scientific courses without the respectable foundation for them.

(d) I do not think that the Princeton experiment is a feasbile thing for a large number of students; however, I am very much interested in the idea back of this experiment which is to interest students at a very early age in geology. We all realize that numbers of geologists come by way of the early boy habit of collecting. I dare say that most of our paleontologists and mineralogists came through that route.

(e) There is an advantage in stimulating interest in geology among high school students but it seems to me that the average high school boy does not have a sufficient background in science to benefit to any great extent from such a course.

(f) I think the plan is excellent in that it introduces students to geology under the most favorable circumstances, i.e. in the field. Furthermore, it fills a need resulting from the fact that few high schools offer geology courses, whereas almost all offer chemistry and physics. In other words, it gives high school students an opportunity to find out what geology has to offer, as well as the other physical sciences. I should like to go further, and suggest that a move be started to introduce the teaching of geology in the high schools on the same basis as chemistry, and physics. If the reason for the lack of understanding of the usefulness of geology and geologists in modern warfare is to be found anywhere, I suspect it is in that we do not start soon enough in introducing people to it.

(g) In my opinion consideration of the Princeton experiment should be tabled until after the war.

(h) With regard to the Princeton plan of offering courses to high school pre-seniors, our own experience has been that the ordinary freshmen are so poorly grounded in fundamental mathematics, physics, and chemistry that they are hardly prepared to appreciate the fundamental geologic relations until the sophomore or junior year. On the other hand, the "edge" of keen interest is frequently removed by high school courses in geology, and I fear this might be true to some extent of such courses as Princeton has been offering. Few high school students have had sufficient training in solid geometry and descriptive geometry to appreciate viewing things with the three dimensional perspective so necessary in many types of geologic observations.

(i) The Princeton experiment is a bold attempt to meet a long recognized problem confronting geology departments, Since geology is the application of mathematics, physics, chemistry, and biology to the earth, it is desirable that a student in geology have some knowledge of these basic subjects before he begins the study of geology, and these are commonly prerequisites to courses in geology. The result is that geology is the last science to which a student is introduced. By that time, many students have already chosen to enter one of the basic subjects and are lost as geology prospects. Yet, if they enter geology courses before attaining some knowledge of the basic sciences, the intellectual and academic level of those courses must be correspondingly lowered. The tendency will be for them to proceed to more advanced courses in geology, because they have already "had" the introductory courses, and get along without the desirable background in the basic subjects. The final product will be geology majors with a weak foundation. The complaint in the past has been that many geology students have inadequate training in the basic sciences. The Princeton experiment will meet the problem of attracting more men into geology. It will be an interesting experiment to watch, but should be regarded as an experiment until its success may be fully established.

3. *The teaching of geology for application in warfare.*—While all are agreed that officers in Army and Navy, and all fliers should have some knowledge of geology, there is considerable divergence of opinion as to how, when, and where the subject should be taught for use in the present war. All are agreed that it should be taught in the future. The following quotations from letters written by members of our committee will indicate the trend of ideas.

There is little disposition among authorities to include any geology *per se* in prescribed courses for Army and Navy trainees.

I question the advisability of now recommending a geological curriculum in military training.

I would not recommend to universities that they teach "military geology."

Now is the time to start teaching military geology, however long the war. If it is not taught during this war, it probably will not be taught after the war is over.

We should encourage the introduction of a geological course in our military curriculum, rather than a course in military geology in our geological departments.

Geology must be added to the list of subjects offered at our naval and army schools.

These comments by members of the committee were frequently duplicated by those professors who replied to the questionnaire. Briefly we may summarize the consensus as follows.

(a) Every effort should be made to urge the introduction of the teaching of geology at such schools as West Point and Annapolis.

(b) In the teaching of geology at military and naval institutions, the object should be, not to make geologists out of officers, but to point out where geology, applied by experts, can be of help in military and naval operations. This can well be done by citing actual examples, along with the basic instruction (see #6, below).

(c) For present needs, each larger military unit should have a staff of well trained and experienced geologists as advisors.

(d) "Military geology," as such, should not be offered as a course in a regular college curriculum. Instead, engineering geology should be taught, with pertinent examples of the application to military uses.

These points are well summarized by one of our correspondents, from whom we quote.

I take for granted that all teachers of geology now are making constant applications of their subject by discussing in their classes the present miliary campaigns. I think too that boys who are going into the Army should be given every opportunity to take as much geology as possible. The trouble about organizing a military curriculum just now lies in the fact that the Army needs the services of mature, widely trained geologists.

However, I do not think that there is any question that any officer would be much more efficient if he had training in courses in general geology, physiography, and the use of topographic maps. Any knowledge which has to do with terrain certainly would be of value to an officer.

In this connection, I remember a statement . rom one of my own boys who was an officer connected with the placement of men. "Whenever," he said, "I find a man who has had training with topographic maps, I mark him as officer material." I think this is significant.

Recently, I have been reading a number of books to see just how a knowledge of physiography might be beneficial to an officer. For example, I have read Karl von Clausewitz *On War* and Ferdinand Foch *The Principles of War*. Terrain, with shock and fire power, often turns the battle tide.

I have been able to secure many of the references in the bibliography of the G. S. A. As I study them, I think that it is more and more the duty of our geological organizations definitely to urge that geology be made a part of the training at West Point and Annapolis.

4. *Subjects that should be taught.*—In our third report* we listed certain subjects which were suggested as appropriate in a course, or in a curriculum that would stress the applications of geology to army and navy operations. These we list here with additions and modifications resulting from suggestions from our correspondents.

a. The geology of water resources, both surface and subsurface; their occurrence, recovery, and utilization. Also the rejuvenation of damaged wells

b. Geology in relation to camp location, camp sanitation, drainage, *et cetera*

c. Geology, as related to the location of roads, railroads, airfields, heavy-gun emplacements, docks, *et cetera*

d. The topography and physiography of land forms in relation to troop movements, military strategy and tactics

e. The use of aerial photographs in the recognition of land forms and surface features

f. The nature of streams as bearing on their use as defense lines, as barriers to movement, and as aids in transportation

g. Types of shore lines and their relation to landing operations

h. The geology of earth (rock) materials for the construction of roads, airfields, fortifications, *et cetera*

i. The geology of soils

5. *Textbooks.*—Textbooks and reference books suggested for teaching the relations of geology to military and naval operations are the following.

D. W. Johnson, *Battlefields of the World War*
H. E. Gregory's *Military Geology and Geography*
R. F. Legget's *Geology and Engineering*
Ries and Watson's *Engineering Geology*
C. F. Tolman's *Groundwater*
Chas. E. Erdmann's "Application of Geology to the Principles of War," *Bull. Geol. Soc. America*, Vol. 54 (1943), pp. 1169–94.
Siegrist and Platt's "Bibliography of Military Geology and Geography," *Geol. Soc. America*

* *Bull. Amer. Assoc. Petrol. Geol.*, Vol. 27 (1943), p. 696.

6. *Examples of the value of geological knowledge in warfare.*—Several cases illustrating how geological information may be of use under conditions of modern warfare were cited in our questionnaire with the request that more be reported. These, together with several more examples, are here outlined.

(a) An army aviator, on a recent visit to his Alma Mater, was asked what course of study he had taken at the university had helped him most in flying. He replied, "Geology." He had found that an elementary course in geology enabled him to recognize the terrain over which he was flying and, on one occasion, told him that he was lost because of a recognizable difference in landforms.

(b) A coast defense battery on the Pacific Coast was thrown out of adjustment by the discharge of a single gun, because this battery was located on a block that had slumped from an escarpment.

(c) A trench for water line was excavated for a considerable distance transverse to the bedding of a formation made up, for the most part, of thin-bedded limestone. A better route might have followed the strike along one of the soft members, with only a short part of the course across the strike.

(d) An air field, because of political considerations, was located in a swamp. Problems of drainage and cut-and-fill were inevitably involved. The location of "borrow pits" and the most effective way of draining the swamp were geological problems.

(e) An air field, which was constructed on a slightly sloping surface, had a bad water problem since during rains the lower half of the field became flooded. In surfacing the field a shallow bed of permeable sand was exposed about midway down the field and during rains this sand simply poured water out onto the field. This difficulty was very simply cured by a geologist who was on the ground. He had a trench cut across the upper end of the field, which went through the water-bearing sand and diverted the water flow.

(f) An attempt was made to secure water for an air field by drilling a well on a knob of metamorphic rock which projected above the coastal plain. The only chance to get water was in crevices of this rock, and only a trickle was obtained. Half a mile away the heavy sands and gravels of the coastal plain were saturated with water.

(g) There have been cases of ground-water pollution due to improper location and construction of sewage disposal systems.

(h) Floods encountered in certain areas, where the army was advancing, caused difficulties which could have been largely avoided by a knowledge of hydrography.

(i) About 2 years ago it was proposed to construct a large cantonment on the edge of a high range of hills. The requirements were a broad flat area for the cantonment and, adjacent to it, a rolling-to-mountainous area, partly wooded, for maneuvers. A group of officers visited the area and obtained information about possible sites by inquiring among the residents. They planned to tour the area and inspect these sites, but in advance they visited the geological department of the local university to look at the topographic maps. They were shown that much more information could be obtained from geologic maps. The contour interval on the topographic maps was too great to reveal the difference between flat areas and gently rolling hills, but the geologic maps indicated the distribution of terrace deposits, so that three suitable areas were easily selected from among many which looked possible on the topographic maps.

(j) At a certain camp, situated on the Atlantic coastal plain, 10 wells were ordered drilled to 4,000 feet, without any consideration of the geology of the region. It could easily have been shown that crystallines would be encountered at about 2,000 ft. and that no potable water be obtained below about 500 ft. The wells were started big enough to go to 4,000 ft. and deep-well pumps were obtained. They started in Pleistocene and found abundant artesian water at less than 400 feet.

(k) It is reported that the advance of the British in North Africa was greatly assisted by advice from a geologist who had specialized on sand dunes and desert topography.

(l) On an island in the Pacific a superior officer ordered that a road be macadamized with a volcanic tuff which was exposed in the vicinity. After the work was completed, the rainy season came on and the tuff disintegrated to such an extent that the army vehicles bogged down. Upon learning that one of the younger officers was a geological engineer, the offlcer in charge instructed him to investigate the situation. The geologist discovered that the tuff was highly altered and contained a substantial amount of clay. Upon examining other exposures on the island, he found an outcrop of volcanic breccia, still in a good state of preservation, close to the road. When this material was employed, the road held up excellently, even during the wet seasons.

Summary.—We may summarize the main opinions expressed by our committee members and to our committee by teachers of geology as follows.

(1) Accelerated courses in geology should not be continued after the war emergency ceases to exist.

(2) Opportunities should be given to High School students to learn something of the

meaning and scope of geology, but care should be taken to see that such early instruction be not substituted for more advanced fundamental training of university grade.

(3) Military geology, as such, should not be taught in our college curricula, but, in the teaching of general geology and especially engineering geology, every opportunity should be taken to illustrate applications of this science to warfare.

(4) By all means geology should be introduced into the curricula of our military and naval schools to the end that our army and navy officers will appreciate the importance of geology in modern warfare.

F. H. LAHEE, *chairman*

EXHIBIT XIII. REPORT OF RESEARCH COMMITTEE

A majority of the members of the research committee attended the annual business meeting of the committee at Dallas, Texas, March 21, 1944. The following business was reported and approved.

PRESENT PROJECTS

1. *Tectonic map of the United States.*—P. B. King reports that color proof will be ready within the next few weeks. Date of publication remains uncertain.

2. *Permian volume.*—Preparation of this volume is being suspended for the duration, according to the editor, R. K. DeFord.

3. *Report on migration and accumulation of oil.*—Results of earlier conferences and questionnaire arranged by Van Tuyl and Parker are expected to reach mimeograph stage during the coming year. Appropriation of $50 by the Association to meet publication expense is recommended by the research committee.

4. *Review of petroleum geology in 1943.*—Second annual survey and bibliography of new developments and thought in petroleum geology, geophysics, and engineering by the faculty of the Colorado School of Mines, arranged by Professor F. M. Van Tuyl, will be summarized at Association meeting and published in full in the April, 1944, issue of the Colorado School of Mines *Quarterly*. In the future a contribution by the Association of $200 or less for abstracting and searching of literature may be needed when graduate student help is again available.

5. *Relation of crude-oil characteristics to stratigraphy.*—Lack of laboratory facilities has prevented making additional analyses for the Tulsa Geological Society project of study of petroleum from Mid-Continent fields. Attention is called to reports of similar studies by Crawford, Dickey, and Bell, and Barr, Morton, and Richards.

6. *Study groups.*—Present conditions discourage either the continuation or organization of study groups. However, a new group studying the petrology of sediments is active at Midland, Texas. Meetings were devoted first to more precise meaning and use of petrographic terms, subsequently to regional problems of petrology. Certain other research groups continue meetings more or less regularly.

7. *Research conferences.*—Continuation of conferences sponsored by the research committee as part of the annual meeting of the Association meetings was approved, the subjects and arrangements to be determined later. At the 1944 meeting in Dallas, the following conferences had attendance approximately as follows: Connate Waters, 150; Estimation of Reserves, 200; Origin of Oil, 350; Petrology of Sediments, 350.

8. *Special volume on geology of South America.*—Progress is being made on this special volume which is to include translation of former papers and of several new papers, publication being planned within 2 or 3 years by the Association. The geological map of South America sponsored by the Geological Society of America may reach preliminary publication stage late this year. A. I. Levorsen is chairman for both of these projects.

NEW BUSINESS

Resolutions were adopted as follows.

1. That the Association publish a special volume on the "Geology of Condensate-Type Fields."

2. That the Association take steps looking forward to the ultimate publication of one or more special volumes on oil fields outside continental United States.

3. That the associate editors should secure articles for the *Bulletin* extending description and giving reanalysis, where needed, of older fields, especially fields of large yield or of special significance.

4. Suggesting that the executive committee send letters of commendation to the American Petroleum Institute and its appropriate committees for the important research work being done under A.P.I. Research Projects 43 a, b, and c, entitled "Transformation of Organic Matter to Petroleum and Recognition of Source Beds," and express appreciation of the important contributions to the Association programs which have been and are being made by those active in these research projects.

5. Recommending that the Association should offer financial support of as much as $1,000 toward the geological map of South America; $1,000 for A.P.I. Research Project 43; and financial support when possible to similar appropriate projects as a matter of general policy.

6. That the research committee invite the East Texas Geological Society to develop a symposium on the East Texas basin for presentation at the general evening meeting sponsored by the research committee at the next annual meeting of the Association. Presumably study groups will be arranged to assemble and coördinate the evidence bearing on fundamental problems of petroleum geology, the East Texas Society inviting the coöperation of other societies, as may appear desirable. Subsequent symposia of other important basins are contemplated.

M. G. Cheney, *chairman*

Exhibit XIV. Report of Representative on Division of Geology and Geography of National Research Council, 1943–1944

Reference is made to the November, 1943, issue of the *Bulletin* for report of the annual meeting and of the current activities of the Division of Geology and Geography of the National Research Council.

Subsequent developments include the publication of the following reports.

1. "Report of the Committee on Marine Ecology as Related to Paleontology, 1942–1943," Harry S. Ladd, chairman, 32 pp.; price, $0.50 (National Research Council, The National Academy of Sciences, 2101 Constitution Ave., Washington 25, D. C.).
2. "Report of the Committee on the Measurement of Geologic Time, 1942–1943," A. C. Lane, chairman, 40 pp.; price, $0.50.
3. Correlation chart Number 12 prepared under the auspices of the Committee on Stratigraphy: "Correlation of the Cenozoic Formations of the Atlantic and Gulf Coastal Plain and Caribbean Region," by C. Wythe Cooke, Julia Gardner, and Wendell P. Woodring, *Bull. Geol. Soc. America*, Vol. 54 (1943), pp. 1713–23.

Similar charts on the marine Cenozoic formations of western North America by Chas. E. Weaver, chairman, and on Pennsylvanian formations of North America, Major Raymond C. Moore, chairman, will be published likewise at early date.

Transactions of the 24th Annual Meeting (1943) of the American Geophysical Union were published by the National Research Council in three parts.

Part I. Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography, Volcanology, and Tectonophysics, October, 1943, pp. 1–332; price, $3.50.
Part II. Section of Hydrology, January, 1944, pp. 333–783; price, $4.00.
Part III. Section of Hydrology, November, 1943, pp. 1–99; price, $1.00.

Orders for these publications should be addressed to General Secretary, American Geophysical Union, 5241 Broad Branch Road, N.W., Washington 15, D. C.; checks payable to "American Geophysical Union."

While chairman of the Division of Geology and Geography, Walter H. Bucher, in a paper entitled "National Research Council and Cooperation in Geological Research," discussed the past, present, and future activities of the National Research Council. Its services to geology can come both in the field of geology proper and particularly in the borderland fields between geology and other sciences. This article was published in the *Bulletin* of The Geological Society of America, Vol. 53 (1942), pp. 1331–54.

M. G. Cheney, *representative*

MINUTES OF BUSINESS COMMITTEE
BAKER HOTEL, DALLAS, TEXAS

March 21, 1944

The meeting was called to order at 1:45 P.M. by Orval L. Brace, chairman.

The following members were present.

Executive Committee: A. Rodger Denison, Fritz L. Aurin, Robert W. Clark, Robert E. Rettger, and Carey Croneis

Business Committee: Orval L. Brace, chairman; Robert W. Clark, vice-chairman; Robert E. Rettger, secretary

Members-at-large: Walter R. Berger, R. I. Dickey, Frank A. Morgan, E. O. Markham, W. B. Heroy

Division of Paleontology: J. Harlan Johnson, H. B. Stenzel

District Representatives:

Amarillo: Elisha A. Paschal

Appalachian: M. Gordon Gulley

Capital: L. W. Stephenson (represented by Ralph W. Imlay)

Dallas: Dilworth S. Hager

East Oklahoma: Lucian H. Walker (represented by W. B. Wilson), R.Clare Coffin, T. C. Hiestand (represented by A. K. Wilhelm)

Fort Worth: C. E. Yager

Great Lakes: Darsie A. Green, Edward G. Cole (represented by Stanley G. Elder)

Houston: W. B. Moore (represented by George S. Buchanan); S. G. Gray, R. C. Bowles, Leslie Bowling

Michigan: Rex P. Grant

New Mexico: Hugh A. Tanner (represented by W. E. Scott)

New York: Lewis G. Weeks

Pacific Coast: James C. Kimble (represented by W. D. Kleinpell), Karl Arleth (represented by R. G. Reese), Max L. Krueger (represented by Harold W. Hoots)

Rocky Mountain: Charles S. Lavington

Shreveport: J. D. Aimer

South America: Philip E. Nolan (represented by Roger H. Sherman)

Southeast Gulf: Tom McGlothlin (represented by Henry N. Toler)

Southern Louisiana: Gordon I. Atwater

South Permian Basin: Oscar R. Champion

South Texas: Robert N. Kolm

Tyler: T. C. Cash

West Oklahoma: R. W. Camp

Wichita: William C. Imbt

Wichita Falls: W. C. Bean (represented by Robert Roth)

1. *Seating of representatives.*—Motion was made, seconded, and carried that members of the business committee not present at roll call may be recorded by the secretary if they report to him at the close of the session.

2. *Minutes of previous meeting.*—It was moved, seconded, and carried that the reading of the minutes of the last meeting of the committee be dispensed with, as they had been published in the *Bulletin*, and that the minutes of said meeting be adopted without change.

3. *Report of special national service committee, K. C. Heald, chairman (Exhibit VI).*—It was moved, seconded, and carried unanimously that the report, with its recommendations, be accepted and referred to the annual business meeting, with the recommendation that it be not read, but that it be published in the *Bulletin.*

4. *Report of committee for publication, J. V. Howell, chairman (Exhibit VII).*—It was moved, seconded, and carried unanimously that the report be accepted and referred to the annual business meeting, with the recommendation that it be not read, but that it be published in the *Bulletin.*

5. *Report of committee on geologic names and correlations, John G. Bartram, chairman (Exhibit VIII).*—It was moved, seconded, and carried unanimously that the report be accepted and referred to the annual business meeting, with the recommendation that it be not read, but that it be published in the *Bulletin.*

6. *Report of committee on applications of geology, Paul Weaver, chairman (Exhibit IX).*—It was moved, seconded, and carried that the report, with its recommendations, be accepted and referred to the annual business meeting, with the recommendation that it be not read, but that it be published in the *Bulletin.*

7. *Report of medal award committee, A. R. Denison, chairman (Exhibit X).*—It was moved, seconded, and carried unanimously that the report be accepted and referred to the annual business meeting, with the recommendation that it be not read, but that it be published in the *Bulletin.*

8. *Report of special distinguished lecture committee, John L. Ferguson, chairman (Exhibit XI).*—It was moved, seconded, and carried unanimously that the report be accepted and referred to the annual business meeting, with the recommendation that it be not read, but that it be published in the *Bulletin.*

9. *Report of special committee on college curricula in petroleum geology, F. H. Lahee, chairman (Exhibit XII).*—It was moved, seconded, and carried unanimously that the report, with its recommendations, be accepted and referred to the annual business meeting, with the recommendation that it be not read, but that it be published in the *Bulletin.*

10. *Report of research committee, M. G. Cheney, chairman (Exhibit XIII).*—It was moved, seconded, and carried that the report, with its recommendations, be accepted and referred to the annual business meeting, with the recommendation that it be not read, but that it be published in the *Bulletin.*

Adjournment of the first session was at 3:45 P.M.

(Recess)

The meeting was called to order at 4:00 P.M. by Orval L. Brace, chairman.

11. *New Business*

A. A. Rodger Denison presented recommendations made by the executive committee to the business committee as follows.

(1) The executive committee at their annual meeting on March 20, 1944, passed a resolution asking the business committee to approve and recommend to the annual business meeting the following changes in the constitution.

ARTICLE I. Name. Delete the words—"the 21st day of April, 1924, for a period of twenty (20) years."

ARTICLE II. Object. Delete the words—"to maintain a high standard of professional conduct on the part of its members; and to protect the public from the work of inadequately trained and unscrupulous persons posing as petroleum geologists."

Motion was made, seconded, and carried that the business committee approve the resolution and recommend such changes to the annual business meeting.

(2) The executive committee requests that the business committee approve and recommend to the annual business meeting the following changes in the by-laws.

ARTICLE I, Sec. 2. That the fourth sentence be amended so as to read—"A bill shall be mailed to each member and associate before December first of each year . . . *et cetera.*"

That the fifth sentence be amended so as to read—"Members or associates who shall fail to pay their annual dues by January first shall not receive copies of the January *Bulletin* or . . . *et cetera.*"

Motion was made, seconded, and carried unanimously that this resolution be accepted and referred to the annual business meeting.

(3) The executive committee desires to recommend to the business committee that they pass the following motion.

That the incoming executive committee be instructed to appoint a special committee to study the code of ethics of the Association. That said committee be instructed to make a report to the business committee at the annual business meeting in 1945 in which they will recommend—

1. Official adoption of the present code of ethics by the membership at the annual business meeting; or
2. The official adoption of a revised and amended code of ethics by the membership at the annual business meeting; or
3. The official abandonment of any code of ethics by the membership at the annual business meeting.

The motion was made and seconded that this resulution be accepted and referred to the annual business meeting; however, the motion was lost by a vote of 21 opposed and 20 in favor.

(4) The executive committee proposes that the business committee recommend to the annual business meeting the following motion.

That the Maracaibo Regional Section of the American Association of Petroleum Geologists be dissolved and its charter revoked.

Motion was made, seconded, and carried that this resolution be accepted and referred to the annual business meeting.

B. Leslie Bowling offered the following motion.

That the executive committee appoint a special committee to formulate a revised code of ethics to be submitted to the Association for adoption at the next annual meeting.

Oscar R. Champion proposed the following amendment.

That a copy of the new proposed code be placed before the membership-at-large through the medium of the *Bulletin* at least sixty (60) days prior to the next annual meeting.

The amendment was seconded.

Robert Roth made the following amendment to the amendment, which was seconded but voted down: That before any new code of ethics be adopted that it be closely scrutinized by a tax expert.

The motion as amended was passed.

C. The following proposal, signed by seventy-five (75) members of the Southern Permian Basin District was presented for the consideration of the business committee by Oscar R. Champion, district representative. A motion was made and seconded that it be accepted.

> The undersigned members of the American Association of Petroleum Geologists propose that Section 2 of Article IV of the constitution of the Association be amended so as to read in full as follows.
>
> SECTION 2. Annual nominations of officers shall be made from the Association at large in writing signed by not less than twenty-five members in good standing and shall be received at the headquarters of the Association not later than the 15th day of January preceding the annual meeting. If written nomination for any office is not so received, the executive committee shall make one or more nominations for each such office. Election of officers shall be held by means of secret mail ballots prior to the annual meeting. If no one of the candidates for any office receives a majority of the votes cast for that office on the first balloting, a second mail balloting between the two candidates receiving the highest and the second highest number of votes for such office shall be held. In the case of ties the president shall cast an additional deciding vote. When more than two members are nominated for any office, the first balloting shall be completed by the 15th day of February preceding the annual meeting so as to allow time for a second balloting, if necessary. In any event all balloting shall be completed by the 15th day of March or one week before the announced date of the annual meeting, whichever is earlier. The newly elected officers shall take office at the conclusion of the annual meeting. *Each candidate, when voted for as a candidate for the particular office for which he is nominated, shall be thereby automatically voted for as a candidate for the executive committee for one year, except that candidates for the presidency shall be automatically voted for as candidates for the executive committee for two years.*
>
> Furthermore, consistently with this amendment, the undersigned members propose that the last word of Article VI of the constitution of the Association be changed from *elected* to *announced.*

The following amendment to the motion was offered by M. Gordon Gulley, seconded, and carried.

> That a committee be appointed to study this constitutional amendment, checking with the executive committee as to the legality of the proposal and return it for final action to the business committee next year.

The motion as amended was defeated by a vote of 18 opposed and 16 in favor.

D. The following changes and additions to the constitution and by-laws, which were proposed and signed by nineteen (19) members of the Southern Permian Basin District, were presented for the consideration of the business committee by R. I. Dickey, member at large. It was moved and seconded that the proposal be accepted. (Proposed additions are italicized and proposed deletions are in parentheses.)

> Article VII: "Amendments to this constitution may be proposed by a resolution of the executive committee, by a constitutional committee appointed by the president, (or) in writing by any ten members of the Association *or by a petition signed by one hundred members of the Association.* All resolutions or proposals *except as otherwise provided for herein,* must be submitted at the annual meeting of the business committee of the Association as provided in the by-laws and (only) the business committee shall make recommendations concerning proposed constitutional changes at the annual Association business meeting. If (such) recommendations by the business committee shall be favorably acted on at the annual Association business meeting, *and in any event upon receipt of a petition signed by one hundred or more members of the Association* the secretary-treasurer shall arrange for a ballot of the membership by mail within thirty days

after said annual Association business meeting, *or within thirty days after receipt of said petition bearing one hundred or more signatures as the case may be*, and a majority vote of the ballots received within ninety days of their mailing shall be sufficient to amend. *Said petition, bearing one hundred or more signatures shall be addressed to the executive committee.* The legality of all amendments must be determined by the executive committee prior to balloting."

By-Laws.

Delete the word "all" from the last sentence of Article VI, Section 2, where reference is made to " . . . (all) proposed changes in the constitution or by-laws. . . . "

Article VII. "Amendments: These by-laws may be amended by a vote of three-fourths of the members present and voting at any annual meeting, provided that such changes shall have been recommended to the meeting by the business committee, *or by mail ballot which shall be prepared and mailed to all members within thirty days after receipt by the executive committee of a petition requesting amendment and signed by one hundred members or more. In the event of a mail ballot, a majority vote of the ballots received after ninety days of their mailing shall be sufficient to amend.* The legality of all proposed amendments shall be determined by the executive committee prior to publication."

Article VIII. "Referendum: Any new proposal or any previous action taken by the Association, its officers or committees may be brought to a vote of the Association membership by means of a petition, addressed to the executive committee and signed by one hundred or more members. The legality of such a petition shall be determined by the executive committee. If found legal, the secretary-treasurer shall arrange for a ballot of the membership by mail within thirty days of receipt of the petition, and a majority of the ballots received within ninety days after their mailing date shall be considered sufficient to reflect the will of the Association."

The following amendment to the motion was made by W. B. Wilson, seconded, and carried (12 for; 10 against): That the petition of 100 members, not more than one-third of which shall be from any one district. . . .

The motion as amended was lost without count or showing of hands.

E. A motion was made by Charles S. Lavington and seconded that the resolution, as follows, proposed by the Rocky Mountain Association of Petroleum Geologists be accepted.

WHEREAS, under the provisions of the Selective Service Activity and Occupation Bulletin No. 33-6, amended January 6, 1944, and effective February 15, 1944, only 125 students of geology and geophysics have been deferred in the United States; and

WHEREAS, this allocation was based on a similar figure reported in January, 1944, as majoring in geology and geophysics by the institutions interviewed by the War Manpower Commission; and

WHEREAS, the January, 1944, student enrollment in these professions is but a small fraction of the peacetime enrollment; and

WHEREAS, the number of 125 students of geology and geophysics, eligible for deferment within two years of graduation, is about 60 graduates a year which is less than one tenth of the number graduating annually in peacetime, and considerably less than one tenth of the present estimated shortage of these students; and

WHEREAS, the number of students of geology and geophysics has steadily declined since the 1938–39 peak, as reported to the A.I.M.E. by the Mineral Industries Education Division; and

WHEREAS, a further decline in the number of these students will seriously affect the finding and producing of minerals essential to the war effort and to post-war recovery, especially petroleum;

NOW, THEREFORE, BE IT RESOLVED THAT the American Association of

Petroleum Geologists, the Society of Exploration Geophysicists, and the Society of Economic Paleontologists and Mineralogists be requested to act as follows:

1. Urge the WAR MANPOWER COMMISSION to increase rather than reduce the number of students of geology and geophysics eligible for draft deferment;
2. Assist educational institutions seeking relief under present regulations affecting students of geology and geophysics; and
3. Stress to all geologists and geophysicists the fact that a steady decline in the number of students of these professions began prior to the war, and that they should exert every effort now and hereafter, to further the study and recognition of their professions.

The motion was defeated.

F. The following motion was proposed by S. G. Gray.

That the business committee recommend that the executive committee appoint a special committee to study, prepare, and present a method of election of officers by mail ballot, together with the necessary changes in the constitution and by-laws and providing machinery for the counting of ballots. The method of election so formulated is to be presented for consideration at the business committee meeting in 1945.

Dilworth S. Hager offered the following amendment which was seconded and carried.

That this special committee shall file their report with the executive committee by December 1, 1944, and the executive committee shall send a copy of such report to all district representatives of the A.A.P.G. and to the presidents of the affiliated local societies by January 1, 1945.

The motion as amended was carried.

The meeting was adjourned at 5:45 P.M.

ORVAL L. BRACE, *chairman*
ROBERT E. RETTGER, *secretary*

BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
VOL. 28, NO. 5 (MAY, 1944), PP. 683-695, 4 FIGS.

MEMORIAL

GEORGE OTIS SMITH
(1871–1944)

Dr. George Otis Smith—scientist, administrator, businessman, philanthropist, and, above all, public servant—was born at Hodgdon, Maine, February 22, 1871, and died at Augusta, Maine, January 10, 1944, at the age of 72 years, 10 months, and 19 days. Able and personable, he spent—as the appended brief biography shows—an active and fruitful life promoting the welfare of worthy persons and worthy things.

As a youth, Smith assisted his father in publishing the *Skowhegan Independent Reporter* and also published a small paper of his own. He was editor of his college paper and correspondent of a Boston paper; in fact, his uncle, editor of the *St. Louis Globe Democrat*, planned a newspaper career for him.

At Colby College, "Go" Smith's receptive mind was well implanted by the sound teaching of W. S. Bayley, professor of geology there from 1888 to 1904, and at the University of Illinois for many years thereafter. In graduate work at The Johns Hopkins University, Smith came under the stimulating influence of strong researchers in geology, winning on merit in his last year the geological department's University Fellowship. The fact that he shared this prize with the runner-up, who needed the money to finish his course, showed his generous character.

Smith joined the United States Geological Survey as assistant geologist in 1896, and, as the appended list of scientific writings shows, carried out varied geologic investigations from Maine to the Pacific Coast. In 1907 he was appointed director of the Survey, a post which he filled with great distinction until 1930, except in 1922 and 1923, when he was a member of the United States Coal Commission.

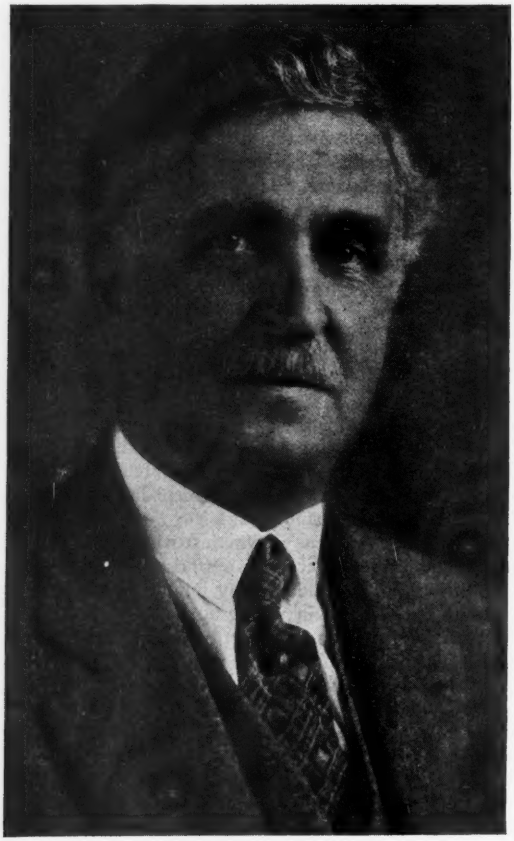
Smith was appointed director of the Survey just when there arose in the Department of the Interior a pressing need for an accurate appraisal of our mineral wealth. Under his general supervision this appraisal yielded many important economic and scientific data and trained many young geologists; in fact, graduates of Survey field camps—and the roster is long and weighty—formed a solid part of the foundation upon which petroleum geology was firmly established during the first world war and has since evolved. His administration of the varied duties of the Survey—including the many that are non-geological—and his aggressive leadership in important extra-Survey affairs brought him many honors, assignments, friends, and tributes, including this recent one by the Secretary of the Interior, Harold L. Ickes:

> Under the leadership of Dr. George Otis Smith the Geological Survey truly came of age to assume the position which it now holds as the leading organization of its kind in the world. At the time of his appointment he was by far the youngest man to hold the position of Director of the Survey but his sound business judgment, which he had earlier evidenced as a member of the Commission appointed by President Cleveland to study the problems of business in government, had much to do with the growth and stability of the organization which he directed so well for more than twenty years.
>
> From the time of his appointment as an Assistant Geologist, in 1896, until his retirement as Chairman of the Federal Power Commission in November 1933, Dr. Smith served the Government and the people of this country, as well as the field of science in which his interests lay, with the whole-hearted directness and forcefulness which were so outstandingly characteristic of him.

Smith was not a bureaucrat in the sense that that word is commonly used. He conceived the Survey as an organization to serve the public promptly, graciously, and effectively, weighing all complaints and requests in terms of public welfare and making decisions accordingly. As time went on, he addressed himself vigorously and successfully,

through administration, writings, and addresses, to the task of conserving our national resources—principally metals, coal, water power, and oil.

In 1930, Smith was appointed chairman of the Federal Power Commission by President Hoover, an action that eventually resulted in a furore and finally landed in the lap of the Supreme Court. Being a first-class administrator, above political maneuvering, un-



George Otis Smith

deviatingly honest, and informed, he was sworn into office for the purpose of administering impartially laws providing for the regulation of public utilities in the public interest. Political efforts to oust him failed when the Supreme Court ruled in 1932 that the Senate had no power to revoke a nomination it had confirmed. Apropos of this, it is ironic that after 36 years of outstanding service this loyal public servant should be haled before the Supreme Court in a legal case titled "The United States of America against George Otis Smith."

In late 1933, Smith resigned from the Federal Power Commission and went home to serve Maine, Skowhegan, and Colby College. Settling down on the banks of the Kennebec, he was characteristically a leader in civic affairs and advisor to many organizations and persons inside and outside the state, being, he said, so busy that he didn't have time for anything that he didn't want to do.

Smith died suddenly just a few hours after leaving his old college on one of his frequent visits to offer counsel and good will.

BRIEF BIOGRAPHY

Born, Hodgdon, Me., Feb. 22, 1871. Son of Emma Mayo and Joseph Otis Smith. A.B., Colby College, 1893; Ph.D., Johns Hopkins, 1896; Sc.D., Case School of Applied Science, 1914; LL.D., Colby College, 1920; Sc.D., Colorado School of Mines, 1928. Married Grace M. Coburn (Colby '93) (deceased). Children, Charles C. (Colby '20) (deceased), Joseph C. (Colby '24), Helen C. (Colby '27), Elizabeth C. (deceased), Louise C. (Colby, '33). Assistant geologist, U. S. Geological Survey, 1896; geologist, 1901; director, 1907–1930. Chairman, Federal Power Commission, 1930–33. Fellow, Geological Society of America; past-president, American Institute of Mining and Metallurgical Engineers; trustee, National Geographic Society; honorary member, Coal Mining Institute of America; member, Washington Academy of Sciences, American Forestry Association, Mining and Metallurgical Society of America, American Association of Petroleum Geologists, New England Council, Press Club, Cosmos Club, Phi Beta Kappa, Delta Kappa Epsilon. Recipient of the Daly Gold Medal from American Geographic Society, 1920. Delegate to international geologic or engineering congresses in Mexico City, Stockholm, London, Tokyo. Contributor to National Geographic Magazine, Atlantic Monthly, Colliers, Current History, Wall Street Journal, and various scientific, technical and trade journals. Author of numerous geologic reports and papers. Editor and co-author of "The Strategy of Minerals," 1919. Member, Bethany Baptist Church, Skowhegan, Me. Trustee, Calvary Baptist Church, Washington. Past-president, Washington Y.M.C.A. Onetime member, National Council of Y.M.C.A., National Council of Boy Scouts of America. Honorary member, Skowhegan Rotary Club. Member, Maine Military Defense Commission. Director, Central Maine Power Company. President, Redington Memorial Hospital, Skowhegan Chamber of Commerce, Trustees of Bloomfield Academy. Trustee, University of Chicago, Coburn Classical Institute. Good Will Farm, Somerset Woods Trustees. Trustee, Colby College since 1903 and chairman since 1934. Died, January 10, 1944.

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CARROLL E. DOBBIN

U. S. GEOLOGICAL SURVEY
DENVER, COLORADO
March 21, 1944

ARTHUR JERROLD TIEJE
(1891–1944)

Arthur Jerrold Tieje was born in Dayton, Ohio. Graduated from Cornell University, he took his doctorate in English at the University of Illinois in 1912, and later (1914–17) was instructor in scientific composition at the University of Minnesota. Because of poor health, he was attracted to the study of geology as a means of getting out of doors, and in 1920 received the degree of Doctor of Philosophy in geology from the University of Minnesota, having been instructor in geology from 1918 to 1920.

He was assistant professor of geology at the University of Colorado from 1920 to 1922, and while there published papers on underground water and sedimentation. Two papers on the latter subject, appearing in the *Journal of Geology*, have been widely cited.

Coming to California, he was paleontologist for the Los Angeles Museum of Science, History, and Art until 1924, when he joined the staff of the University of Southern California as associate professor of geology. In 1927 he was appointed to full professorship, and was made chairman of the department of geology, holding the latter post until 1934. Probably his most important paper during this time was on the Pliocene and Pleistocene history of the Baldwin Hills, published in the *Bulletin* of the American Association of Petroleum Geologists in 1926.

For three successive summers (1930–33) Dr. Tieje was head of the geology sessions at Columbia University, and later he spent his summers in travelling widely, visiting Australia, China, the Philippine Islands, and Tahiti. In 1938, on sabbatical leave, he made a trip around the world, spending considerable time in Burma and the Netherlands East Indies. One of his last trips was to Argentina, in the summer of 1941.

While in Burma, he became interested in the larger Foraminifera of the Burmese Tertiary, and on his return began a study of these for the Geological Survey of India. This

work was carried on by successive graduate students under Dr. Tieje's direction, and was nearing completion at the time of his death. It will be completed for publication by the latest student to work with him.

During the last few years Dr. Tieje was troubled considerably by his eyes, but these had begun to show some improvement, although his general health had not been good for the past several months. He continued to teach until in the first week in January, when he was ordered to the hospital for observation concerning a condition of the digestive tract. He was operated on a week later, but the operation was not successful, and death came to him January 25, 1944.

Jerry Tieje's chief monument is his students. Those who studied paleontology under him have gone out to oil companies throughout California, as well as in many other parts of the world. In them, and in the hearts of his friends, he still lives.

T. D. Clements

University of Southern California
Los Angeles, California
April, 1944

EDWARD OSCAR ULRICH
(1857–1944)

Edward Oscar Ulrich, internationally known geologist and paleontologist, honorary member of the American Association of Petroleum Geologists, passed away peacefully at his Washington home February 22, 1944, in his 88th year, after a brief illness.

His parents, both natives of Alsace, France, emigrated to the United States in 1840, locating at Cincinnati, Ohio, where his father entered business as a contractor. It was here that Edward was born February 1, 1857. He attended the public schools at Cincinnati and at Covington, Kentucky, where the family later made their home.

It was by chance that Edward's youthful collecting instincts were directed to fossils, when Reverend Henry Herzer, Methodist minister of the family church and geologist in his own right, told the 7-year old boy the meaning of the curious stones scattered over the local hills. When 15 years old, being tall for his age, he secured a job as rodman in the Cincinnati Water Works, working chiefly in the excavations for the Eden reservoir, the type area of the very fossiliferous Eden shale, offering further incentive for fossil collecting and study. After about two years of this work his father persuaded him to attend the German Wallace and Baldwin Colleges at Berea, Ohio, in preparation for the ministry, and then later the Ohio Medical College at Cincinnati. However, his love for fossils conquered the pressure put upon him to continue his scholastic education so that at the age of 20 he was glad to accept his first scientific position, the curatorship of the Cincinnati Society of Natural History. Two years later, employment as superintendent of the Little Caribou Silver Mines in Boulder County, Colorado, provided him opportunity for experience in geology on a broader scale. In 1883 he was back at Cincinnati collecting and studying fossils again, while at the same time earning just enough to exist by odd jobs, as draftsman and lithographer, which abilities were developed by his own efforts.

His artistic work included the illustration of fossils for several local scientists and attracted such favorable attention that from 1885 to 1897 he had employment as a free lance geologist and paleontologist on the Illinois, Minnesota, Ohio, and Kentucky State surveys. During this time his early monographs on Paleozoic invertebrate fossils, all illustrated by himself, were published.

A new phase in life commenced with his appointment, when 40 years old, to the United States Geological Survey, opening the way for broader work in the fields he liked best. He remained with the Survey 35 years, until his retirement in 1932. Then his fruitful

life was rounded out at the United States National Museum, as honorary associate in paleontology, by 12 years of research on the stratigraphic notes and great collections of Lower Paleozoic fossils he had accumulated during his years of active field work on the Federal Survey.

Doctor Ulrich was an original fellow of the Geological Society of America and also of the Paleontological Society, which he served as president. He was a member of the National Academy of Sciences, the Academy of Natural Sciences of Philadelphia, of Sigma Xi, and other scientific societies, and corresponding member of the Geological Society of London and the Geological Society of Stockholm. Various honors in recognition of his researches came to him. The National Academy of Sciences in 1930 awarded him the Mary Clark Thompson medal for his attainments in paleontology, and in 1932 the Geological Society of America honored him with the Penrose medal for his contributions to geology. His college at Berea, Ohio, paid tribute by bestowing the honorary degrees of M.A. in 1886, and D.Sc. in 1892.

EDWARD OSCAR ULRICH

As one of the pioneers in the study of the stony bryozoa by means of thin sections, his classification and early monographs on the subject were the basis for all subsequent studies. He was an outstanding authority on the strange tooth-like conodonts and Paleozoic

ostracoda, two groups as valuable in oil geology as the foraminifera. It was his special pleasure to undertake the study of the lesser known groups of fossils, such as the sponges, gastropods, and cephalopods, usually neglected by paleontologists because of their commonly poor preservation and consequent difficulty of investigation. The many stratigraphic and paleontologic reports prepared for the folios and monographs by other geologists during his service with the United States Geological Survey, attest to the breadth of his work along these lines. Studies in paleogeography and the principles of diastrophism naturally followed his researches in fossils and correlation. Such economic papers as those dealing with the copper deposits of Missouri, and the lead, zinc, and fluorspar of western Kentucky, also occupied his efforts as need for them arose in the Survey. Several trips to Europe gave the opportunity to check his results in America with the classic areas abroad. His bibliography of scientific papers covers more than 120 titles.

Generous to a fault, Dr. Ulrich was always ready to give of his time to helping others. Indeed, his associates and many friends will not forget his happy, kindly nature. Fortunately, as noted, his larger taxonomic works in paleontology appeared in his earlier years, because in later life he was so engrossed in applying his knowledge of fossils to broader studies of correlation and diastrophism. The results of some years of the latter studies were embodied in his classic "Revision of the Paleozoic System," explaining his principles of stratigraphy and introducing radical changes in the classification of Early Paleozoic rocks. Unfortunately the paleontologic foundation for this work never appeared in print, except in a few cases where his association with younger men made publication possible.

Doctor Ulrich was the last of the Cincinnati geologists who attained eminence in the science without full university training. His remarkable memory made recollection of all he read easy. Being a prodigious reader, he early in life assimilated a great fund of information for later research work. He had a rare photographic mind for the names and characteristics of actually thousands of species of fossils so that he was never at a loss to reproduce from memory the geological sequence and faunal contents of the many rock outcrops studied in North America and Europe.

His paleontologic results are preserved in his large private collection of Paleozoic invertebrates with its thousands of type specimens, made before joining the Federal Survey, and the great quantities of study material from subsequent official field work, all now housed in the United States National Museum where they are available for comparison and research.

Doctor Ulrich leaves his widow, Mrs. Lydia Sennhauser Ulrich, of Aadorf, Switzerland, whom he married in London in 1935.

No outline of Dr. Ulrich's life is complete without mention of his faithful, lifelong assistant, Rector Duvall Mesler. A graduate in geology of the University of Arkansas and student of Professor A. H. Purdue, "Rec" was appointed to the United States Geological Survey in 1911 as assistant to Dr. Ulrich. A fine collector and skilled preparator, with a devotion to detail, he had just the talents to aid in forwarding Dr. Ulrich's researches and to care properly for the great collections the two were soon accumulating. He was active in this work to the last, for during a few moments' rest immediately preceding Dr. Ulrich's funeral service on Friday, February 25, he passed on to join his chief.

R. S. Bassler

United States National Museum
Washington 25, D. C.
March 14, 1944

CURTIS HALL MONTGOMERY
(1897–1944)

The many friends of Curtis Hall Montgomery were deeply shocked and grieved to learn of his untimely death on February 22, 1944, at the Monte Sano Hospital in Glendale, California. Death came suddenly and without much warning; he had been stricken but a few days before at his home in Pasadena, California. Only three weeks previously he had been transferred by his company from the Bakersfield area, where he had made his home for many years, to the Los Angeles office in order to assume new duties in the Los Angeles Basin area.

"Monty" was a native Californian, born in Antioch, a small country town in the vicinity of Oakland, California, on November 27, 1897, and christened Curtis Hall Montgomery by his parents. To his many associates, the drillers, roughnecks, pumpers, geologists, engineers, technicians, and executives who comprise the California oil fraternity, he was more affectionately known as Hall, or Monty, which I think he secretly appreciated more than his more formal baptismal name.

Monty lived his entire life in California, attending grade school in various towns where his parents happened to live. Graduating from Turlock High School in the spring of 1916, he entered the University of California at Berkeley that fall semester, where he spent the next 4 years in company with his Sigma Pi fraternity brothers, busily laying the groundwork for his subsequent professional life. His major studies were geology and petroleum engineering, in which he received his degree of Bachelor of Arts in the spring of 1920. World War I, for the United States, started and finished while he was in college. Although he was too young for military service at that time, he enlisted in the United States Navy R.O.T.C. unit on the campus. Not having seen active naval duty in World War I, Monty tried desperately to render active service in the present World War II, but age again kept him a civilian, and Monty had to be content to contribute his effort as a petroleum engineer.

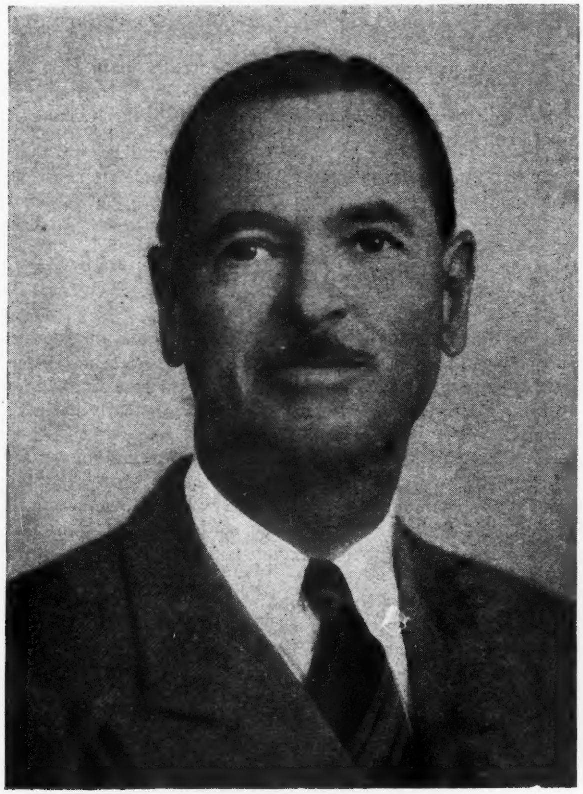
No thought of Monty was complete without that integral part of him, his family. While in college he was attracted to a classmate, Doris Peoples, whom he married on the New Year's Eve following their graduation. With his marriage began a New Year, and a new full life for Monty. During the subsequent years, throughout his development from a trainee to an accomplished petroleum engineer, throughout his migrations from one California oil-producing center to another, Doris provided the direction of purpose that was one of his most valuable assets. To them was born, in 1922, a son, Curtis Hall Montgomery, Jr., now an officer in the United States Army Air Force. "Skiz" was the pride of his father and his almost inseparable companion.

Shortly after graduation from the University, in August, 1920, Monty entered the employ of the Shell Oil Company as a trainee where he gained experience first at Coalinga, then later in the Los Angeles Basin area during the flush-production period of Santa Fe Springs, Signal Hill, and Huntington Beach. In February, 1925, Monty joined the geological staff of the Marland Oil Company, now the Continental Oil Company, with whom he remained until his untimely death on February 22, 1944. The greater portion of his work for the company was in the San Joaquin area.

When Continental Oil pioneered the development of the Kettleman Hills North Dome oil field, Monty was resident geologist. Later, he was transferred from Coalinga to Bakersfield, and it was during this period that he had the geological direction of the Continental KCL A-2, the Wasco field discovery well, and the deepest oil well in the world. Monty's loyalty to the company superseded his personal desires; his full time and interest were given to each assignment. His thinking was sound, although sometimes at variance with orthodox treatments. As a consequence, he was always present at the operations under his supervision, watching the true conditions, and justifying his theories and decisions. Recog-

nition of his outstanding work in the San Joaquin Valley was responsible for his transfer to the Los Angeles headquarters of the company just prior to his death.

Monty became a member of the American Association of Petroleum Geologists in 1937. He was sponsored by his friends John Galloway, H. D. Hobson, and Roy M. Barnes. During his period of membership he took a very active part in Association affairs, and never



CURTIS HALL MONTGOMERY

willingly missed a meeting. He was also a prominent member of the American Petroleum Institute and at the time of his death he was chairman of the San Joaquin Valley section.

Monty leaves behind him a host of friends throughout California. His home in Stockdale, in Bakersfield, was frequently the scene of many lively informal gatherings. His summer home on the shores of Huntington Lake, in the California High Sierras, where the family trio spent summer week-ends and vacations, was the favorite rendezvous of those many friends who loved the mountains, boating, and fishing. Monty himself was an enthusiastic sportsman.

Monty's fatal illness, probably the first and only serious illness of his life, came completely unheralded and lasted scarcely more than a week. On the day before he was rushed to the hospital he was full of vigor and enthusiasm, happy over his new work, making plans for the future, helping to get his new home ready for the entertainment of his friends. Eight days later he passed away.

In addition to his widow, Doris, and son, Curtis Hall, Jr., Monty is survived by his mother, Mrs. Curtis Franklin Montgomery, of Stockton, California; and two sisters Mrs. Lawrence Lake of San Raphael, California, and Mrs. John F. Curry, of Denver, Colorado.

The pattern of life is such that all of us will eventually make that exploration trip across the River Styx, and we may once more travel the same trail with Monty. In the meantime, however, we are left with the memory of one of the finest chaps that it has been our good fortune to call a friend.

GRAYDON OLIVER

LOS ANGELES, CALIFORNIA
March 29, 1944

FREEMAN WARD
(1879–1943)

The death of Dr. Freeman Ward at Easton, Pennsylvania, on September 14, 1943, marks the passing of one of the geological pioneers of this Association. His pioneering, however, was a matter of place rather than time, since his efforts were directed toward bringing the attention of the oil industry to South Dakota during the early period of prospecting on the Great Plains.

Born in Yankton, South Dakota, the son of a Congregational missionary, Joseph, and Sarah Ward, on August 9, 1879, his early youth was spent in the new state. One of his early experiences was as a chainman on a federal survey party, completing the land survey in the Rosebud and Pine Ridge Indian reservations in western South Dakota. The acquaintance he then gained with this new region may have had a good deal to do with arousing his interest in geology.

Three years of his undergraduate schooling were spent in the denominational college founded by his father at Yankton, Yankton College. This was followed by two years at Yale University where he received his bachelor's degree in 1903. Five years later, in 1908, he was granted the degree of Doctor of Philosophy in geology by the same University.

Then followed a twelve-year period as assistant instructor in the geological department at Yale University before he came back to his native state as professor of geology at the State University of South Dakota in the fall of 1915. This position carried with it the position of State geologist and the direction of the State Geological Survey. This small survey had been in operation since 1893, during which time the general framework of South Dakota's geology had been developed by N. H. Darton, James Todd, and C. C. O'Harra. Realizing that about all had been done that could be done by hasty reconnaissance of large areas, Dr. Ward attempted to amplify the general information with detailed surveys of small areas. Interest in oil prospecting on the Great Plains reached South Dakota about 1921, and increased appropriations for the Geological Survey enabled him to attack the problem of the state's petroleum possibilities vigorously. Nineteen publications resulted, describing the stratigraphy and structure in various parts of the state where mapping could be profitably done. These added a great deal to the information on South Dakota then available, and stimulated prospecting. Though it did not result in the discovery of a field, this work added much to the geology as it was then known and laid a foundation for later geologic work.

As State geologist, however, Dr. Ward's interests were not confined to oil and gas geology. Geographic studies, surveys of sands, gravels, clays, chalk rock, and the biological features of the state are recorded in the publications he supervised. In all, thirty reports on South Dakota geology and natural history resulted from his administration of the Survey.

In 1926 he left South Dakota to become head of the department of geology at Lafayette College, Easton, Pennsylvania, bringing to a close his active field work as a petroleum geologist. This position he held until he died from a heart attack last September.

Dr. Ward became a member of our Association in 1921 and held his membership until his death with the exception of a year in 1929 and 1930. He was also a member of the Geological Society of America, the American Association for the Advancement of Science and his local scientific organizations.

His main interest was his teaching, which he had highly systematized. His success is attested by the large enrollment in his classes and a number of successful geologists whose interest in the science was due to his inspiration. With his passing, the profession has lost not only an active scientist but a good teacher.

E. P. Rothrock

Vermillion, South Dakota
April 4, 1944

WILLIAM C. STEUBING
(1881–1943)

On October 28, 1943, at San Antonio, Texas, there passed away one of the early oil geologists of South Texas. William C. Steubing died at the Nix Hospital of an obscure anemia from which he had been suffering for some time. His death, mourned by his many friends, recalls to them the difficulties he overcame for many years while maintaining his production in the lean shallow pools close to San Antonio.

Born in Louisville, Kentucky, on May 4, 1881, William C. Steubing began early in life an education in mining and geology that included a mining engineering degree from the Michigan College of Mines in 1904, and after an interval of practical work, a Master's degree at Columbia University in 1912. During this period he excelled in these studies and was elected to the honorary fraternity of Tau Beta Pi. Immediately after graduation he resumed his work with the Helvetia Copper Company at the mines in Arizona where he later became general manager and vice-president. In 1919 he interested his company in oil production and moved to San Antonio, Texas, where he lived until his death. He acquired several tracts of land in the area of the Somerset pool in Atascosa County and ultimately drilled more than a hundred wells thereon under the name of the Helvetia Oil Company. At this time he became a member of the American Association of Petroleum Geologists, one of the first from the San Antonio area. In 1941 he purchased the interest of the parent company in the producing properties and became the sole owner. The fact that he was able to maintain these very small producing properties for such a long time speaks eloquently of his ability as an organizer and efficient producer. Never an extensive operator, he pioneered several producing areas with leases and royalties. His company initiated several minor discoveries as a result of his geological studies and clear thinking.

Early in life he married Maud Bechtel of Victoria, Canada, who brought to him a charming personality and companionship which was reflected in his entire life. She and an adult son, William C. Steubing, Jr., survive him.

Although never a person to seek publicity or aggressively to push his personal interests, he created friends by his quiet sincerity, tenacity of purpose, and fair dealing. These friends

are conscious of a deep sense of loss at the passing of a good neighbor and a good business example.

J. EARLE BROWN

FORT WORTH, TEXAS
April 18, 1944

EDWARD VIRGIL WINTERER
(1897–1944)

A feeling of great sorrow was experienced by the many friends of Edward Virgil Winterer, chief geologist of the Superior Oil Company, when they learned of his death on March 14, 1944, following an operation from which he never recovered.

He was a geologist of the highest attainments, and to know him well was to receive a stimulating, vigorous conception of the science which he so splendidly served. It is to be

EDWARD VIRGIL WINTERER

regretted his inclinations did not lean toward technical writing so that a greater number of geologists could have benefited from the thoughts of his clear and logical mind.

Very few of his numerous friends knew him as other than "Tubby" Winterer. He was born on November 20, 1897, in Valley City, North Dakota. It was in California, however, that he spent most of his life and received his education. He joined the Navy during the first World War, and was in officer training course at the time of the Armistice. He then returned to the University of California at Berkeley; was graduated with the class of 1921;

and received a Master of Science degree in 1922, specializing in agronomy in the department of agriculture. He continued at the University, teaching soil technology and doing research along the same line for the next 5 years. Deciding to take up geology as a life work, he spent the next 2 years obtaining a Bachelor of Science degree in that subject. He was a member of Theta Xi fraternity.

In 1928, Mr. Winterer started his association with the Superior Oil Company and served continuously with this company until his recent illness. During the last 5 years, he was at the head of the geological department of the company and was given constantly expanding responsibilities. Besides exploration activities in California, he had under his supervision similar work in Oklahoma, Kansas, West Texas, and the Rocky Mountain states. It was largely as a result of his detailed geologic knowledge of the San Joaquin Valley in California that his company now holds such an enviable position in the prolific Greeley, Rio Bravo, and Coalinga Eocene oil fields. He organized and carried out combined geological and geophysical investigations of large areas in New Zealand; made several reconnaissance trips through various countries in both South and Central America; and planned exploration programs in other foreign districts. Just prior to his death, Mr. Winterer was made a vice-president and director of the newly formed Superior Oil Company of Venezuela.

The foreign travel, close association with nature, and the problems of geology were greatly to his liking, and few men had greater satisfaction or contentment in their work. His professional growth was steady and productive, and his capabilities were greatly respected by those in the petroleum industry who had the good fortune to know him well. As a hobby, he developed photography to a high degree of proficiency and was recently working on a device for progressively photographing astronomical bodies.

He is survived by his wife, Lorraine Litton Winterer, to whom he was married in 1923 and whose tastes and ideals in life were always very congenial to his own; and by his two children, Jerry and Joan.

E. R. Atwill

Los Angeles, California
April 17, 1944

BULLETIN OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS
VOL. 28, NO. 5 (MAY, 1944), PP. 696-700

AT HOME AND ABROAD

CURRENT NEWS AND PERSONAL ITEMS OF THE PROFESSION

R. B. NEWCOMBE has resigned as assistant director of production for District 2, Petroleum Administration for War, Chicago, to join the Superior Oil Company of California, at Grand Rapids, Michigan.

LOWELL R. LAUDON, of the University of Kansas, spoke on "The Canol Project," at the meeting of the Tulsa Geological Society, April 10.

LOUIS C. SASS is with the Mene Grande Oil Company, Barcelona, Venezuela.

DANIEL A. BUSCH, formerly with the Pennsylvania Topographic and Geological Survey, is with Huntley and Huntley, Pittsburgh, Pennsylvania.

Lieutenant R. V. BROWNE, formerly with the Iraq Petroleum Company in Palestine, is now with the Survey of India.

Lieutenant THEODORE G. FISHER is a petroleum inspector at the Standard Oil Company refinery at Richmond, California.

IVAN J. FENN is geologist with the Salt Dome Oil Corporation, Houston, Texas.

OTTO HACKEL is with the Tide Water Associated Oil Company, Bakersfield, California.

R. V. HOLLINGSWORTH has resigned from the Shell Oil Company, Inc., Midland, Texas.

J. B. BLANCHARD, oil operator, is situated at 150 Leo Avenue, Shreveport, Louisiana.

GEORGE S. BUCHANAN and G. H. HARRINGTON have changed their address to the Yegua Corporation, Esperson Building, Houston, Texas.

J. REX McGEHEE, of the geological staff of the Shell Oil Company, Inc., Tulsa, Oklahoma, was transferred to the Shell Oil Company of California, at Los Angeles, effective April 15. He may be addressed in care of the Shell Oil Company of Canada, Ltd., Bank of Toronto Building, Calgary, Alberta, Canada.

Major J. E. ELLIOTT, of the Dallas Chemical Warfare Procurement Office, has returned to civilian pursuits. His address is 108 West 15th Street, Austin, Texas.

GRANT W. SPANGLER has moved from Shawnee to Tulsa, Oklahoma. He is a senior geologist with the Stanolind Oil and Gas Company.

ROY D. McANINCH is district geologist with the Stanolind Oil and Gas Company at Shawnee, Oklahoma.

Major WILLIAM M. NICHOLLS, of San Antonio, Texas, now in China, sends regards to all his friends. His address is A.P.O. 627, c/o Postmaster, New York.

JULE H. WALKER, formerly with the Ohio Oil Company at San Antonio, is employed as petroleum geologist by the Chicago Corporation at Houston, Texas.

CARL C. BRANSON, has left the department of geology of the University of Kentucky; he is in the exploration department of the Shell Oil Company, Inc., at Houston, Texas.

E. M. BUTTERWORTH is assistant manager of the foreign producing department of the Standard Oil Company of California at San Francisco.

J. BRIAN EBY, consulting geologist, Houston, Texas, has an illustrated article in the *Oil Weekly* of April 17, "Germany Fights for Oil."

E. W. FOSSHAGE is in the employ of Northern Ordnance, Inc., Billings, Montana.

JAMES A. PRICE, district geologist with W. C. McBride, Inc., Tulsa, Oklahoma, for the past 10 years, has accepted a position with Northern Ordnance, Inc., in charge of production at Pleasantville, Pennsylvania.

WILTON W. LARUE has resigned his position as physicist with the Naval Ordnance Laboratory at Washington, and is now employed as geophysicist with the Plymouth Oil Company, Sinton, Texas.

DISTINGUISHED LECTURE TOUR

JOHN EMERY ADAMS, geologist for the Standard Oil Company of Texas at Carlsbad, New Mexico, addressed a group of affiliated societies during April on the subject, "Depth Control of Sedimentation in the Permian Basin." The carefully prepared lecture, based on years of research in the Permian Basin area of West Texas and New Mexico, was presented before the following societies.

April 10 Fort Worth Geological Society at Fort Worth
11 Dallas Petroleum Geologists at Dallas
12 East Texas Geological Society at Tyler
13 Houston Geological Society at Houston
14 South Texas Geological Society at Houston
17 South Louisiana Geological Society at Lake Charles
18 Mississippi Geological Society at Jackson
19 Illinois Geological Society at Olney
21 Michigan Geological Society at Lansing
24 Tulsa Geological Society at Tulsa
25 Oklahoma City Geological Society at Oklahoma City
26 Kansas Geological Society at Wichita
28 Panhandle Geological Society at Amarillo

JOHN L. FERGUSON, *chairman*

CORRECTION

GRABENS IN GULF COAST ANTICLINES AND THEIR RELATION TO OTHER FAULT TROUGHS

The subject of the article by Willis G. Meyer, which was published in the April *Bulletin* should have been printed: "Grabens in Gulf Coast Anticlines and Their Relation to Other Fault Troughs." By an inadvertence the word "Faulted" was printed in the subject of the article in the April issue instead of the word "Fault."

HARRY FAVILL WRIGHT, consulting petroleum engineer and geologist, died at Tulsa, April 15, at the age of 56 years.

CECIL EARL SHOENFELT, formerly owner of Petroleum Information, Inc., Denver, Colorado, died on April 17, at the age of 59 years.

CARROLL H. WEGEMANN, district geologist for the Petroleum Administration for War, Denver, Colorado, spoke on "Little-Known Canyons of the Green and Yampa Rivers, Utah and Colorado," at the meeting of the Rocky Mountain Association of Petroleum Geologists, May 1.

MARVIN LEE, consulting geologist, Wichita, Kansas, is head of the geological and exploration division of the Cooperative Refinery Association.

KENNETH A. ACKLEY is chief scout for the Carter Oil Company, Tulsa, Oklahoma.

MAX W. DAVID is with the Phillips Petroleum Company at Midland, Texas.

CHARLES E. YAGER is executive vice-president of the Texas Pacific Coal and Oil Company.

PAUL W. FOSTER, formerly with the Atlantic Refining Company, is employed by the Barnsdall Oil Company, Houston, Texas.

R. B. RUTLEDGE, of the Skelly Oil Company, Tulsa, described the Velma field, Stephens County, Oklahoma, and V. C. SCOTT, of The Texas Company, Tulsa, described the Apache field, Comanche County, Oklahoma, at the meeting of the Tulsa Geological Society, May 1.

The following officers of the Illinois Geological Society were recently elected: president, FRED H. MOORE, Magnolia Petroleum Company, Mt. Vernon; vice-president, LEE C LAMAR, Carter Oil Company, Mattoon; secretary-treasurer, EVERETT F. STRATTON, Schlumberger Well Surveying Corporation, Mattoon.

HENRY GARDINER SYMONDS, formerly with the Chicago Corporation, Corpus Christi, is now with the Tennessee Gas and Transmission Company, Houston, Texas.

DONALD L. NORLING is employed by the Devonian Oil Company, Tulsa, Oklahoma, after being associated with the Shell Oil Company, Inc., for 7 years.

LYNN W. STORM has returned from Mexico. He may be addressed c/o Sun Oil Company, Dallas, Texas.

LOUIS H. DESJARDINS, aero-geologist, has been designated a research associate in the Princeton University Department of Geological Engineering for the spring quarter.

KILBURN E. ADAMS, formerly geologist in the division offices of The Texas Company in Tulsa, has been transferred as resident geologist to Mt. Pleasant, Michigan, where new offices have been recently established by the company.

S. G. GRAY, of the Tide Water Associated Oil Company, and M. H. STEIG, of the Phillips Petroleum Company, presented a report on "The Erath Field, Vermilion Parish, Louisiana," at the meeting of the Houston Geological Society, May 4.

CHARLES E. STOUT, of the United Fuel Gas Company, Charleston, West Virginia, is secretary-treasurer of the Appalachian Geological Society to complete the term of A. E. PETTIT, who has moved to Mt. Vernon, Illinois.

MARIAN COFFMAN CODY is now in the geological department of the Creole Petroleum Corporation, Caracas, Venezuela.

BENJAMIN H. MARTIN is with the Pan-American Production Company, Raymondsville, Texas.

MEMBERSHIP APPLICATIONS APPROVED FOR PUBLICATION

The executive committee has approved for publication the names of the following candidates for membership in the Association. This does not constitute an election but places the names before the membership at large. If any member has information bearing on the qualifications of these nominees, he should send it promptly to the Executive Committee, Box 979, Tulsa 1, Oklahoma. (Names of sponsors are placed beneath the name of each nominee.)

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Secretary - - - - - - - - - - - W. B. Moore
Atlantic Refining Company, Box 1346
Treasurer - - - - - - - - - - - G. J. Smith
Pan American Producing Company

Regular meeting held the first and third Thursdays at noon (12 o'clock), Mezzanine floor, Texas State Hotel. For any particulars pertaining to the meetings write or call the secretary.

SOUTH TEXAS GEOLOGICAL SOCIETY
SAN ANTONIO, TEXAS

President - - - - - - - - Robert N. Kolm
Atlantic Refining Co., 1742 Milam Building
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Transwestern Oil Co., 1600 Milam Building
Secretary-Treasurer - - - Robert D. Mebane
Saltmount Oil Co., 916 Milam Building

Meetings: One regular meeting each month in San Antonio. Luncheon every Monday noon at Milam Cafeteria, San Antonio.

FORT WORTH GEOLOGICAL SOCIETY
FORT WORTH, TEXAS

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The Texas Company, Box 1720
Vice-President - - - - - - - James L. Morris
The Pure Oil Company, Box 2107
Secretary-Treasurer - - - Spencer R. Normand
Independent Exploration Company
2210 Ft. Worth Natl. Bank Bldg.

Meetings: Luncheon at noon, Hotel Texas, first and third Mondays of each month. Visiting geologists and friends are invited and welcome at all meetings.

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The Ohio Oil Company, 615 Hamilton Bldg.
Vice-President - - - - - - Dolph E. Simic
Cities Service Oil Co.
Secretary-Treasurer - - - Carlos M. Ferguson
Magnolia Petroleum Co., 500 Waggoner Bldg.

Luncheons and evening programs will be announced.

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Vice-President - - - - - - George R. Gibson
Richfield Oil Corporation
Secretary-Treasurer - - - - - - - Jane Ferrell
Magnolia Petroleum Company, Box 633

Meetings will be announced

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United Fuel Gas Company, Box 1273
Editor - - - - - - - - - H. J. Simmons, Jr.
Godfrey L. Cabot, Inc., Box 1473

Meetings: Second Monday, each month, except June, July, and August, at 6:30 P.M., Kanawha Hotel.

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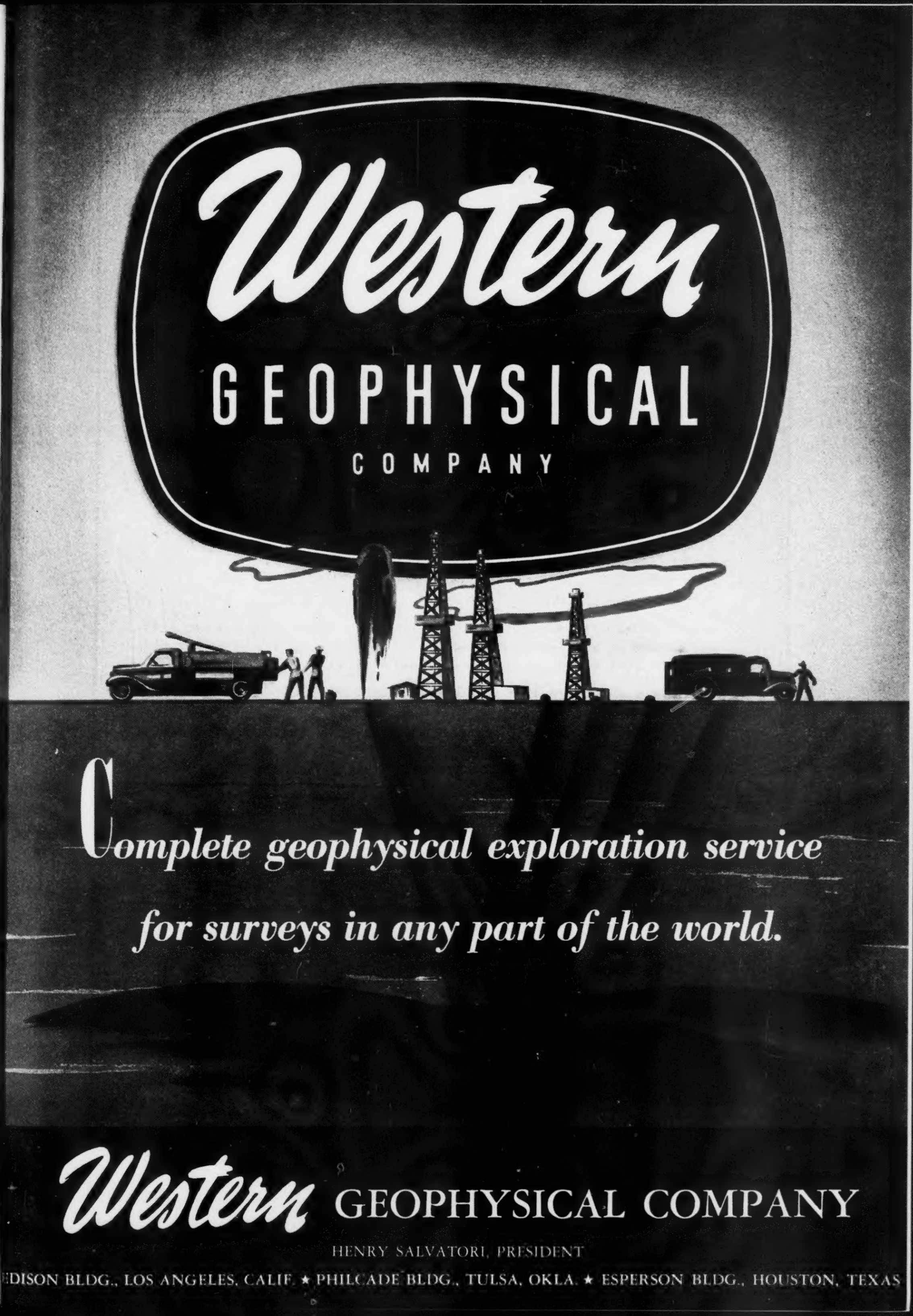
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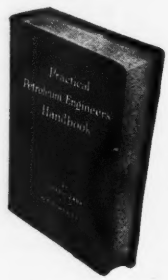

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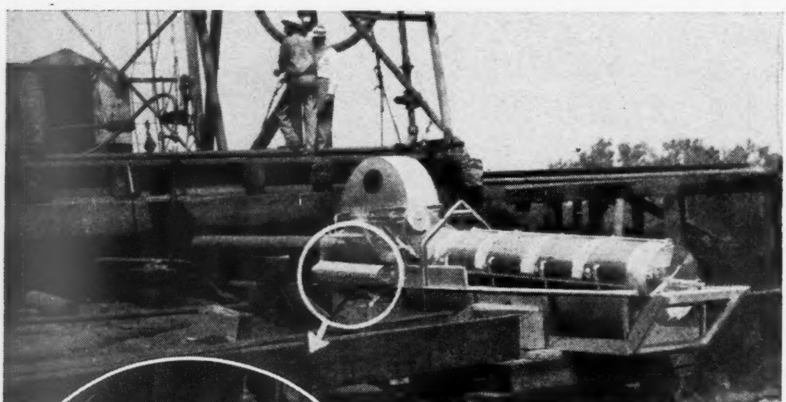

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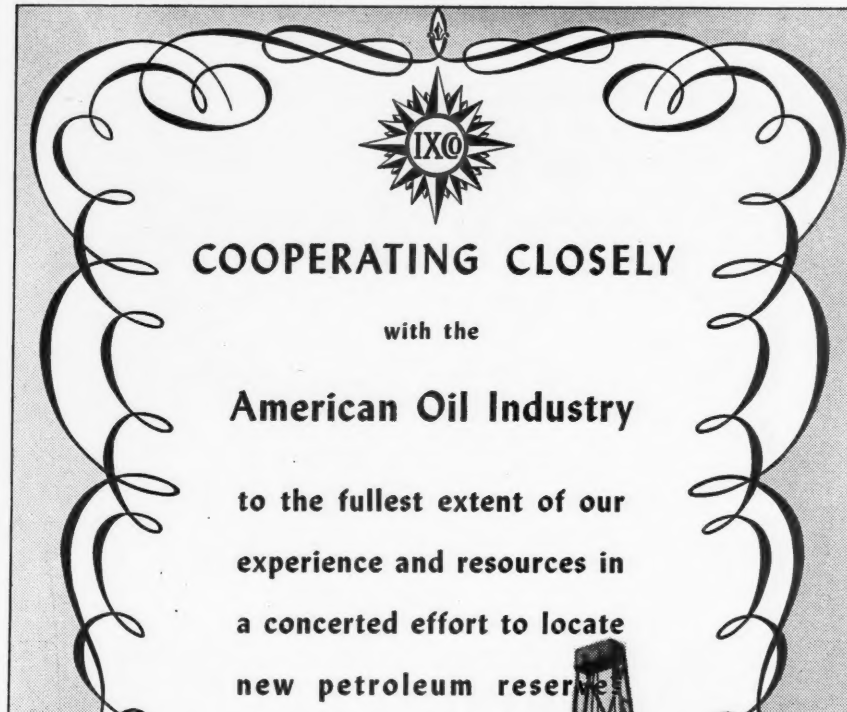
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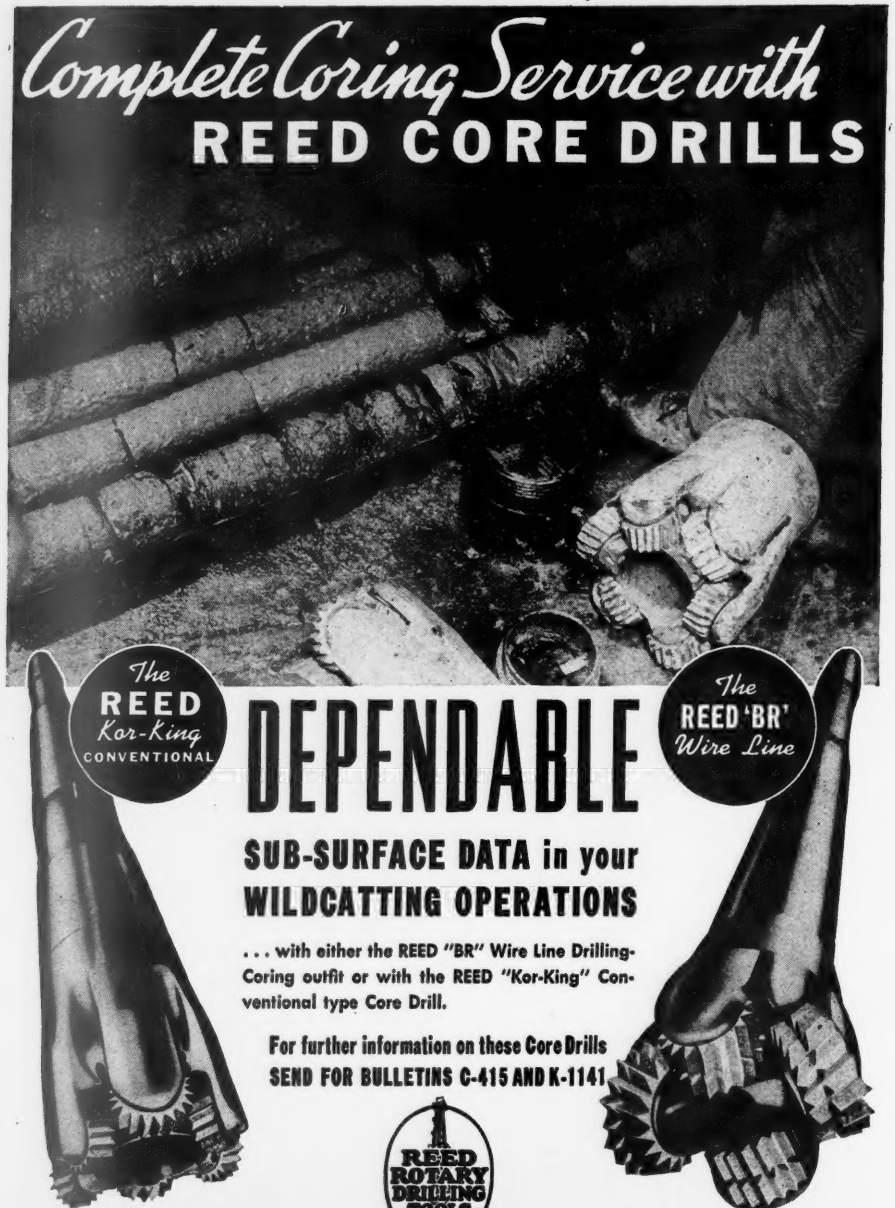
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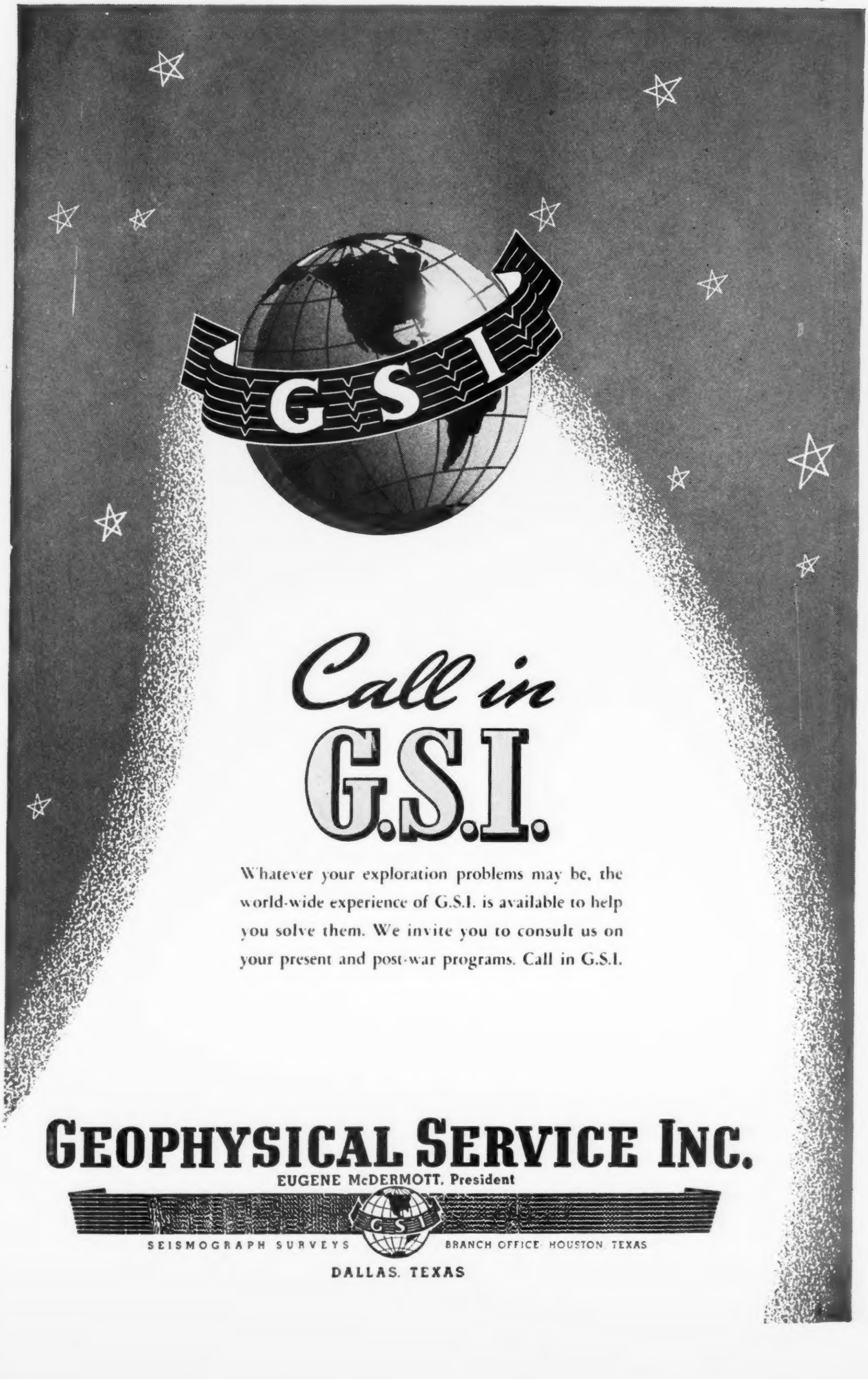
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